

From: Cecily Beall, Environmental Engineering Department
 Date of Contact: October 10, 1985
 Contacted by: Telephone
 Company/Agency: Food and Drug Administration
 Office of Device Evaluation
 Telephone Number: (301) 427-7750
Person(s) Contacted/Title(s)
 George Mills

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The only lists of EO contract sterilizers of which Mr. Mills is aware are very dated and incomplete. There is a registration list of all contract sterilizers of all types, and it may be possible to extract the EO sterilizers. Mr. Mills estimates that there are between 50 and 70 EO contract sterilizers in the U.S. Ms. Sarah Mowitt (301-427-7215) would know more about this list, and she will be back in the office on October 15, 1985. Mr. Mills believes that a letter making a request for information and giving EPA contract number, etc., may be required before data can be released.

Mr. Mills thinks that there may be some information on EO sterilizers in files in his office. He will search through them, talk to some other people, and call me back on October 15 or 16.

Mr. Mills also suggested the following contacts in FDA:

1. Center for Drugs and Biologics
 Director - Harry Meyer, M.D.
 301-443-2894
2. Center for Food Safety and Applied Nutrition
 Director - Sanford White, Ph.D.
 202-245-8850
3. Center for Veterinary Medicine
 Director - Lester Crawford, DVM, Ph.D.
 301-443-3450

From: Margery A. Cassidy, Environmental Engineering Department

Date of Contact: 11/25/86

Contacted by: Telephone

Company/Agency: Daig
14935 Deveau
Minnetonka, Minnesota 55345

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Telephone Number: (612) 933-4700

Person(s) Contacted/Title(s)

Wesley M. Dawson, Quality Assurance Manager

CONTACT SUMMARY:

I asked Mr. Dawson about the 100 percent efficiency value for their Cordis/Dow scrubber, which was reported on the EPA ethylene oxide information request. He said that the scrubber came with the sterilizer unit, which they bought used. He does not have any information about the model number. The scrubber is not an acid/water scrubber--just water. His rationale for assuming 100 percent efficiency was that when ethylene oxide is mixed with water, the result is ethylene glycol, and, therefore, no ethylene oxide emissions would result.

Wesley M. Dawson
4-1-87

RECEIVED APR - 4 1987

From: Margery A. Cassidy, Environmental Engineering Department

Date of Contact: 11/25/86

Contacted by: Telephone

Company/Agency: Hospital Products Division of Sherwood Medical
108 North Main Street
Sherburne, New York 13460

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Telephone Number: (607) 674-2635

OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Carolyn Predmore

CONTACT SUMMARY:

[Note that this company is no longer part of Chesebrough-Pond's. They are now called "Hospital Products Division of Sherwood Medical"]. Tom Napper, the contact listed on the Section 114 Information Request, referred me to Carolyn Predmore to discuss the issues in question.

Ms. Predmore said that the values for net ethylene oxide used per year for chamber No. 4 on page 3 (17,270 and 1,662 lb/yr) were taken from their 1986 product budget projection. The value presented for calculated emissions on page 7a under 3c (34,437 lb/yr) was calculated on the basis of a report from York Labs and represents a worst-case, full capacity value. Therefore, the values on page 3 are more realistic and should be used for our purposes, according to Ms. Predmore.

With regard to the apparent discrepancy in sterilizer No. 4 efficiency values, Ms. Predmore said that the values were from the York Lab report and that for the 100 percent ethylene oxide mixture, an efficiency of 99.998 percent is correct. For the 12/88 mixture, the efficiency is 99 percent even though they are used in the same chamber.

CONFIRMATION	MAR. 26, 1987
RESPONSE	APR. 2, 1987
MAILED VERBAL NONE	

From: Margery A. Cassidy, Environmental Engineering Department

Date of Contact: 11/26/86

Contacted by: Telephone

Company/Agency: Cal-Compac Food
4906 West First Street
Santa Ana, California 42702

Telephone Number: (714) 775-7757

Person(s) Contacted/Title(s)

Frank Lamb, Plant Manager

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AUG 2 1997

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CONTACT SUMMARY:

Mr. Lamb was contacted for clarification of the information submitted in response to the EPA information response on ethylene oxide.

Mr. Lamb said that the scrubber, which was reported as an emission control device, is not a "scrubber" per se. It is an optional piece of equipment (part of the system) supplied by Vacudyne (the manufacturer of the sterilization chamber). When the gas is removed from the chamber with a vacuum pump it is run through a countercurrent spray of water. The ethylene oxide and water are then pumped to the sewer in a closed system.

Mr. Lamb did not have any model number so I asked him for the address and telephone number for Vacudyne so that we could discuss efficiencies with them.

Vacudyne Corporation
375 East Joe Orr Road
Chicago Heights, Illinois
Telephone: (312) 757-5200

CONFIRMATION	MAR 26 1987
RECEIVED	April 24 1987
WITNESSED	
VERBAL	
NONE	

From: Vicki M. Soltis, Environmental Engineering Department
Date of Contact: 11/26/86
Contacted by: Telephone
Company/Agency: Cook Incorporated
925 S. Curry Pike
Bloomington, Indiana 47401
Telephone Number: (812) 339-2235

RECEIVED

AUG 26 1987

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Larry Price, Engineer

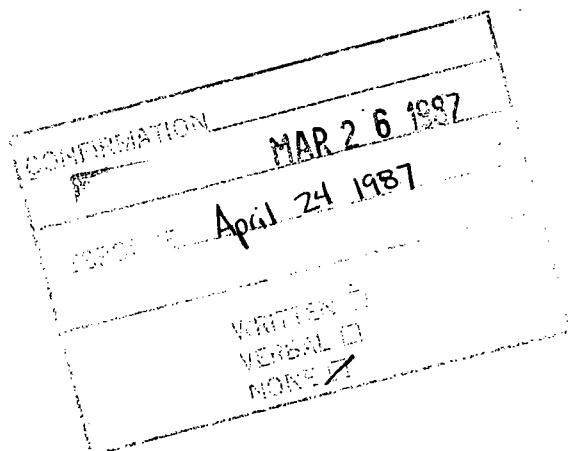
CONTACT SUMMARY:

Mr. Price was contacted for clarification of information submitted in response to the EPA information request on ethylene oxide.

I asked Mr. Price for information which would help determine the breakdown for the ethylene oxide use per chamber. (Ethylene oxide was reported as a combined 8,982 lb/yr for Chambers 6 and 3.) Mr. Price could not give a breakdown other than what was reported, that is, the size of Chamber No. 6 is approximately 3 times that of Chamber No. 3 and Chamber No. 6 is used approximately 2 times as often. Therefore, assuming that the same concentration of ethylene oxide is used in both chambers, ethylene oxide use is approximately 6 times greater for Chamber No. 6 as Chamber No. 3.

I also checked on the accuracy of the gas mixture reported to be used (102,070 lb/yr). It appears that the decimal point was in the wrong place for either total gas used or net ethylene oxide used (which was incorrectly calculated at 88 percent of total = 89,820; and reported as 8,982.) Mr. Price stated that 102,070 is the correct amount.

Based on the above information, I calculated the amount of gas mixture used for Chamber No. 6 to be 87,489 lb/yr and the net ethylene oxide (12/88 mixture used) to be 10,499 lb/yr. Calculated values for Chamber No. 3 are 14,581 lb/yr of gas mixture and 1,750 lb/yr of ethylene oxide.



From: Margery A. Cassidy, Environmental Engineering Department

Date of Contact: 11/26/86

Contacted by: Telephone

Company/Agency: Spicecraft
Flottman Road
Gerald, Missouri 63037

Telephone Number: (314) 764-3396

Person(s) Contacted/Title(s)

Tom Barry, President

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CONTACT SUMMARY:

I called Mr. Barry to ask him more about their sterilization process since the process is different from the typical chambers. He said that it is similar to the Sterijet system but their system is another patented system. They treat each individual product or unit with a polyethylene liner in the vessel. The liner is sealed with the product or unit enclosed and then sterilized. They use an explosion-proof two-way vacuum pump and any ethylene oxide that is left at the end of the cycle is transferred to the water wash ("scrubber").

Both the controlled and uncontrolled sections of the Section 114 Information Request form were filled out because the uncontrolled information represents the part of the process when a given unit is being treated (0.1 minute cycle) and the controlled information represents the time between cycles when the recirculation of the ethylene oxide to the scrubber occurs (0.02 minute cycle).

CONFIRMATION	MAR 26 1987
RESPONSE	April 24 1987
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input checked="" type="checkbox"/>	

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AUG 23 1997

CONTACT REPORT--MRI Project No. 7723-K

A-88-03

II - E - 166

From: OAQPS AIR
DOCKET CONTROL ROOM

Jacqueline Glanville, Environmental Engineering Department

Date of Contact: 11/26/86

Contacted by: Telephone

Company/Agency: Vacudyne Corp.
375 East Joe Orr Road
Chicago Heights, Illinois 60411

Telephone Number: (312) 757-5200

Person(s) Contacted/Title(s)

Ron Greeno, Product Manager

CONFIRMATION
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input type="checkbox"/>

CONTACT SUMMARY:

Mr. Greeno said water is required to (1) cool the gas down to 0°F in the chiller, (2) keep the seal liquid at 90°F in the compressor, and (3) cool the drier bed from 375°F after every second reclamation. The chiller is similar to an air conditioner (a heat exchanger and compressor) and circulates ethylene glycol at -15°F.

Mr. Greeno noted that the condenser is operated at 50 psig. The ethylene oxide/chlorinated fluorocarbon (EO/CFC) gas mixture is then passed through the chiller where it is cooled as a liquified gas to 0°F at a pressure of 20 psig.

Mr. Greeno said that the control efficiency for both the EO and CFC ranges from 60 to 95 percent. The EO and CFC will condense at the same conditions of pressure and temperature even though the boiling points of the two substances are different.

I asked Mr. Greeno how many cycles does the system go through to achieve a control efficiency of 95 percent. Mr. Greeno said that this could be determined from the flow rate through the system (60 ft³/min) and the chamber volume (approximately 60 ft³).

The holding tanks are actually a series of accumulator, blending, and storage tanks. The accumulator tank holds the recovered liquid at a low temperature while the process is recycling the gas. When the recycling is stopped, the liquid from the accumulator is pumped to the reblend tank and analyzed for EO and CFC and brought up to specifications by the addition of either EO or CFC. The accumulator and reblend tanks are maintained at 20 to 30 psig and are cooled by the chiller to about 10°F. After this, the liquified gas is pumped to a storage tank that serves as a storage cylinder and compresses the gas to 60 psig at ambient temperature.

Ethylene glycol is used as the seal liquid in the compressor and in the chiller. Approximately 20 gallons of ethylene glycol are sealed in the compressor permanently and about 110 gallons of ethylene glycol are recirculated in the chiller.

The electricity requirements of the system are 105 kWh per every 90 minute cycle.

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 12/3/86

Contacted by: Telephone

Company/Agency: The Jackson Laboratory
Otter Creek Road
Bar Harbor, Maine 04609

Telephone Number: (207) 288-3371

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Robert Jones, Safety Officer

CONTACT SUMMARY:

Mr. Jones was contacted for clarification of information submitted in response to the EPA information request on ethylene oxide. I asked Mr. Jones about the sizes and comparative usage times for the three sterilizers. (No sizes and only total ethylene oxide used, 562 lb, for all chambers were reported on the Section 114 information request.)

Mr. Jones provided the chamber sizes:

1. 20"x17"x3'
2. 2'x3'x5'
3. 3.5'x3'x7'

Each chamber is used an average of three times per week with the same ethylene oxide concentrations.

CONFIRMATION	MAR 26, 1987
RESPONSE	APR 3, 1987
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 12/4/86

Contacted by: Telephone

Company/Agency: Creative Care Systems, Inc.
8 Hixon Place
Maplewood, New Jersey 07040

Telephone Number: (201) 762-4800

Person(s) Contacted/Title(s)

Gilbert M. Barcus, General Manager

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CONTACT SUMMARY:

Mr. Barcus was contacted for clarification of information submitted in response to the EPA information request on ethylene oxide.

Mr. Barcus first stated that use of the sterilizer was discontinued in June of 1986 and the sterilizer will not be used in the future. Creative Care Systems now has a contract with Griffith Microbiotrol in Levittown, Pennsylvania to sterilize the custom medical trays which they produce.

Mr. Barcus could not provide estimates of the stack height and stack diameter.

CONFIRMATION	MAR 26, 1987
RESPONSE	APR 3, 1987
WAITED <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

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AUG 26 1997

CONTACT REPORT--MRI Project No. 7712-K

A-88-03

II - E - 169

From: OAQPS AIR
DOCKET CONTROL ROOM

Sharon Srebro, Environmental Engineering Department

Date of Contact: 12/29/86

Contacted by: Telephone

Company/Agency: National Distillers and Chemical Corp.
Environmental Safety Department
11500 Northlake Drive
Cincinnati, Ohio 45249

Telephone Number: (513) 530-6798

Person(s) Contacted/Title(s)

Bob Brunson

CONFIRMATION	4-8-87
RESPONSE	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

National Distillers does not use ethylene oxide in sterilization processes.

Robert A. Brunson
April 8, 1987

RECEIVED APR 13 1987

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AUG 20 1997

CONTACT REPORT--MRI Project No. 7723-K

A-88-03

II - E - 170

DOCKET: OAQPS AIR
FROM: CONTROL ROOM

Sharon Srebro, Environmental Engineering Department

Date of Contact: 01/20/87

Contacted by: Telephone

Company/Agency: Chemrox, Inc.
217 Long Hills Crossroads
Shelton, Connecticut 06484

Telephone Number: (203) 926-9081

Person(s) Contacted/Title(s)

Pankajh Desai, Vice President of Sales and Marketing

CONFIRMATION	4/15/87
RESPONSE	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Desai was contacted about the following: (1) the Chemrox system for the condensation/reclamation of CFC-12 and (2) the use of a nitrogen and ethylene oxide (EO) mixture for sterilization.

The following points were discussed regarding the CFC reclamation system.

1. Developmental stage of CFC reclamation system--Mr. Desai said that the development of the system has been completed and that the tests currently being conducted are the fine tuning of the system's mechanical components. The first unit will be installed sometime this summer at a facility in Missouri.

2. Reduction of moisture and acid content--The Chemrox reclamation system is designed to recover CFC emissions from the exit stream of an acid-water scrubber, which is used to remove EO at a certain efficiency. Chemrox has a contract with Union Carbide to purchase the recovered CFC-12 from its units. According to Mr. Desai, Union Carbide has set fairly strict standards regarding the EO and water content of the recovered CFC-12. Also, water can cause icing in the condenser. Therefore, the Chemrox system includes a dessicator to reduce the water content before the gas stream enters the compressor. Mr. Desai said that the acid level of the scrubber exit stream is minimal and that any acid present would be reduced in the dessicator because the acid would be in aqueous solution.

3. System pressurized--Yes. However, Mr. Desai stated that at this time he is not allowed to release information regarding the operating pressures.

4. Can the system handle fluctuating flows and cyclic operation?--Yes. The system was designed for those types of operating conditions.

5. Recovery efficiency--Mr. Desai stated that the system is currently designed such that it may or may not be cost effective to operate the system after the first evacuation of the chamber depending on the sterilization cycle

parameters. (However, the system can be modified to operate at a control efficiency level if a CFC-12 regulation is developed.) The system removes >90 percent of the CFC contained in the first evacuation. The percentage of CFC recovered from the total amount used depends on the evacuation procedure. Mr. Desai said that typically, approximately 80 percent of the total CFC used is discharged during the first evacuation. Therefore, approximately 70 to 75 percent of the initial CFC charge is recovered during the first evacuation.

6. Operating costs--Total direct operating costs (including electricity and dessicant) are about \$0.017 per pound of CFC-12 recovered. The system is fully automatic; therefore, labor costs are minimal.

7. Expected life of system--Approximately 10 years.

8. Can the system be used with small sterilizers?--Yes. Technically feasible but not cost effective.

The following points were discussed regarding the use of N₂ and EO mixture for sterilization.

1. Chamber modifications--This mixture can be used in chambers that are designed for 12/88 (EO/CFC-12). Although the N₂/EO mix used in the chambers during sterilization is nonflammable, Chemrox recommends modifying the chamber instrumentation and controls to be explosion-proof because of the use of pure EO in the lines. (The chambers proper do not require any modifications.) Mr. Desai stated that all of Chemrox's clients who have converted to N₂/EO mixtures have made these modifications. He did not give a cost but said that the changes were very cost effective with a payback period in some cases of about 6 months. (The payback period is dependent on the amount of sterilant gas used.)

2. Process description--The sterilization chamber and gas feed lines are purged with pure N₂ prior to sterilization in order to remove as much oxygen as possible before the pure EO is added. The number of purges depends on the sterilizing EO concentration required and on the amount of vacuum allowed for the sterilization process. (The deeper the vacuum, the fewer the purges required. However, some products cannot withstand an extremely low vacuum.) Then, pure EO is added to the N₂ in the chamber until the desired sterilizing parameters are obtained. The operating pressure also depends on the EO concentration and the products ability to withstand a vacuum. The pressure is always negative and can be as low as 2 in. Hg vacuum. The complete cycle (N₂ purges and sterilizing) is conducted under negative pressure.

3. Cost effectiveness--Mr. Desai said that because N₂ is so much cheaper than CFC-12 (about \$0.10/lb N₂ as compared to \$0.75/lb CFC-12) the cost per sterilization load is much lower with this process.

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 1/22/87

Contacted by: Telephone

Company/Agency: Union Carbide, Linde Division
Post Office Box 6744
Somerset, New Jersey 08873

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OAGPS AIR
DOCKET CONTROL ROOM

Telephone Number: (201) 271-2618

Person(s) Contacted/Title(s)

Chip Woltz, Product Manager

CONTACT SUMMARY:

Mr. Woltz was contacted about the prices of pure ethylene oxide, 12/88 (EO/CFC-12), and 10/90 (EO/CO₂). He said that he could not give an exact price because the price range varies so widely depending on quantity ordered and type of container. However, he said that approximately \$1.10/lb is a typical mid-range price for all three products.

CONFIRMATION	<u>received 09/15/87</u>
RESPONSE	<u>change price (done)</u>
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 02/03/87

Contacted by: Telephone

Company/Agency: Vacudyne Corp.
375 E. Joe Orr Road
Chicago Heights, Illinois 60411

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Telephone Number: (312) 757-5200

OAGPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Dick Matthews, Marketing and Sales Director

CONTACT SUMMARY:

Mr. Matthews was asked about the Vacudyne "scrubber", reportedly the control device used by one respondent to the EPA information collection request on the use of ethylene oxide (EO) in sterilization chambers. He replied that Vacudyne does not manufacture a scrubber for the control of EO emissions. He said that the device referred to is probably the liquid-gas separator located on the vacuum pump assembly and is not considered an emissions control device. Mr. Matthews said that ethylene oxide is absorbed into the pump water and then sent down the drain with little or no conversion of EO to ethylene glycol.

CONFIRMATION _____
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

From: Jacqueline Glanville, Environmental Engineering Department

Date of Contact: 2/10/87

Contacted by: Telephone

Company/Agency: Union Carbide
Linde Division
Post Office Box 6744
Somerset, New Jersey 08873

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AUG 2 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (201) 271-2618

Person(s) Contacted/Title(s)

Chip Woltz, Product Manager

CONTACT SUMMARY:

Mr. Woltz stated that any EO/CO₂ mixtures equal to or greater than 20 percent (by weight) EO should be treated as flammable (e.g., 20/80, 30/70, 80/20). Mr. Woltz noted that there is a very small market for 20/80 and 30/70. They are aware of only one customer that uses 80/20.

CONFIRMATION	<u>received 04/15/87</u>
RESPONSE	<u>OK</u>
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 2/18/87

Contacted by: Telephone

Company/Agency: Barnes Hind, Inc.
895 Kifer Road
Sunnyvale, California 94086

Telephone Number: (408) 736-5462

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OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Janet Patzman

CONTACT SUMMARY:

Ms. Patzman was contacted for clarification of information submitted in response to the EPA Section 114 information request on ethylene oxide.

I asked Ms. Patzman about the use of pure ethylene oxide at the facility. Ms. Patzman said that pure ethylene oxide is not used as a sterilant but, if needed, is added to the ethylene oxide/CFC-12 mixture after reclamation to bring the mixture to a 12 percent concentration (weight basis) of ethylene oxide.

I also asked Ms. Patzman if there was a drain on the system that was a source of ethylene oxide emissions. Ms. Patzman said that there are no drain emissions.

Ms. Patzman provided the following additional information. The reclamation system involves condensation of the ethylene oxide first, then condensation of CFC-12. The ethylene oxide and CFC-12 enter a reblend tank where the concentration is monitored and CFC-12 or ethylene oxide is added as needed.

CONFIRMATION	<u>sent on 7/22/87;</u>
	<u>to be rec'd by 8/21/87</u>
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input checked="" type="checkbox"/>	

From: Richard V. Crume, Environmental Engineering Department

Date of Contact: 3/2/87

Contacted by: Telephone

Company/Agency: Sterilization Services of Tennessee
2396 Florida Street
Memphis, Tennessee 38109-2563

RECEIVED

AUG 2 1997

Telephone Number: (901) 947-2217

OAGPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Mr. Pat Adams, General Manager of Sterilization Services

CONTACT SUMMARY:

Mr. Adams was asked the following questions:

QUESTION: What growth is expected to take place in the contract sterilization industry through the year 2000 in the absence of any additional federal regulations?

RESPONSE: A growth rate of about 30 percent above 1986 levels is expected over the next 5 years (i.e., a rate of approximately 6 percent per year), followed by a growth rate of 4 to 5 percent per year above 1986 levels through the year 2000.

It is expected that growth in 12/88 use will parallel any growth in business (i.e., growth in the volume of products sterilized). Any new regulations would probably have the effect of increasing contract sterilization business, but the increase in 12/88 use may not be as great. This is because there would be a trend to replace 12/88 with pure E0, nitrogen/E0, 10/90, and gamma radiation.

The use of pure E0 and 10/90 may not be feasible for some products. For example, the "hottest" item today in the hospital sterilization field is the sterilization of "custom kits." (These are customized kits of surgical tools and supplies.) Due to the fact that these kits cannot be sterilized at low vacuum or high pressure, pure E0 and 10/90 cannot be used. According to Mr. Adams, the use of nitrogen would not be expected to present any product problems but testing might be required on some products; however, he did not elaborate on this.

Another problem with the use of 10/90 as a replacement gas is that existing chambers cannot be modified to withstand the required higher operating pressure. Chambers built to use 12/88 are not ASME coded. ASME coding is required for vessels exceeding 15 psi. Chambers used with 10/90 must be designed and built with ASME materials and per ASME code.

Currently about 60 percent of commercial sterilization is performed using gaseous sterilants. This is expected to decrease to about 50 percent within several years.

The FDA has performed informal studies of commercial sterilization growth. The contact there is: Andrew Lowrey, Small Manufacturers Assistance Administration.

QUESTION: What is the cost to sterilize a load of products?

RESPONSE: The costs are presented below.

Range: \$0.60/cu. ft. to \$1.50/cu. ft.

Averages: \$0.90/cu. ft. (Pure E0)

\$1.30 to 1.40/cu. ft. (12/88)

These costs will vary according to the volume handled per year. Note that any new federal regulations would probably affect prices.

Bulk 12/88 and pure E0 are approximately the same price. However, 12/88 is more expensive to use because: (1) four times as much 12/88 is required, compared to pure E0, for the same load (12/88 contains about 27 percent E0 by volume); and (2) a longer sterilization time is required for 12/88, compared to pure E0, due to the diluent effect that results from freon competing with E0 to penetrate the product packaging.

QUESTION: What is the salvage value of old sterilization chambers?

RESPONSE: Once a chamber has reached the end of its useful lifetime, it is sold for scrap metal. Its value to Sterilization Services is significantly less than 1 percent of the original capital investment.

CONFIRMATION
RESPONSE April 24 1987
WRITTEN <input checked="" type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input type="checkbox"/>

From: Vicki Soltis, Environmental Engineering Department

Date of Contact: 3/2/87

Contacted by: Telephone

Company/Agency: Health Industry Manufacturers Association
1030 Fifteenth Street, N.W.
Washington, D.C. 20005-1598

Telephone Number: (202) 452-8240

Person(s) Contacted/Title(s)

James F. Jorkasky, Director, Manufacturing and Quality Programs

CONTACT SUMMARY:

Mr. Jorkasky was asked the following questions about sterilization in the health industry:

Question: What change in the number of sterilization facilities in the health industry is expected through the year 2000 in the absence of any additional regulations?

Response: In 1983, 132 HIMA member facilities operated 351 sterilizers (OSHA position paper). MRI's analyses of the responses from a survey conducted by HIMA in response to EPA's regulatory initiatives on ethylene oxide (EO) showed that, in 1985, 95 member facilities operated 252 sterilizers (HIMA survey). The results of a new survey were expected in September 1987. The number of facilities in the health industry performing sterilization using EO is decreasing as facilities consolidate or cease operations. A further decrease in the number of facilities is expected from 1985 to 1987. After 1987, the number of facilities performing EO sterilization may stabilize, unless further regulatory initiatives on EO are promulgated.

Question: What change in the use of 12/88 is expected through the year 2000?

Response: Mr. Jorkasky suggested calling Steven Conviser, a manager at the Linde Division on Union Carbide in Sommerset, New Jersey, (201) 271-2602. Also, some facilities are switching to pure EO because of better cycle control and the development of CFC regulations.

Mr. Jorkasky also provided the following information about the sterilization industry.

A. Information about sterilization using Cobalt-60 radiation:

1. Environmental groups are trying to force passage of stringent requirements for the transport of Cobalt-60. This and a concern about the safety of radiation workers and communities around such facilities could affect growth of sterilization using radiation.

2. In-house radiation sterilization is extremely expensive; approximately \$5 million to build and supply a sterilization facility using gamma radiation.

3. Johnson & Johnson and Sherwood Medical are examples of large medical device manufacturers having in-house radiation sterilization capability.

4. The only supplier of Cobalt-60 is Atomic Energy of Canada Limited (AECL). Cobalt-60 is a by-product from the Canadian nuclear industry; the U.S. nuclear industry does not produce Cobalt-60. The supply of Cobalt-60 is, therefore, not reliable.

5. Not everything can be sterilized with radiation. Plastics may degrade, discolor, or become malodorous.

6. Of the approximately 15 to 20 billion products sterilized in the U.S. per year, 60 to 70 percent are sterilized with EO and 30 to 40 percent with Cobalt-60.

B. Information on other alternatives to EO sterilization:

1. Product changes--chemical companies are working on developing plastics that are super heat resistant. These plastics could be sterilized with steam. However, since medical products are final packaged before sterilization, packaging may limit steam sterilization of such plastics. Also, there are many products for which the composition cannot be changed.

2. Sterilant changes--formaldehyde (which is a "high-level disinfectant") and chlorine dioxide (experimental at this point) are possible alternatives. However, the safety of formaldehyde is currently in question by OSHA and EPA, and further information is needed on chlorine dioxide.

C. Contacts:

1. Bahhar Gidwani, Investment Analyst
Kidder Peabody
(212) 510-3816 (New York City)
May 1986 report
2. John Masefeld, Ph.D., President
Isomedix--major contract radiation sterilization corporation,
12 facilities in the U.S.
(201) 887-4700 (New Jersey)
3. Allan Chin, President
Radiation Sterilization, Inc.--major contractor
(415) 854-2800 (Northern California)
4. CFC Alliance--group of CFC producers and users who are looking at regulatory issues.
(703) 841-9363 (Arlington, Virginia)
(1981 document sites 14 uses of freon by HIMA members)

5. Robert Morrissey, Director of Sterilization
Ethicon, a Johnson & Johnson company using irradiation and
researching chlorine dioxide
(201) 218-3175

CONFIRMATION	Aug. 28, 1987
RESPONSE	
WRITTEN <input checked="" type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>	

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A-88-03
RECEIVED

TELEPHONE CONVERSATION SUMMARY

AUG 23 1997

DATE: April 16, 1987

NAME OF PERSON: Michael DeMarco, JH141

ORGANIZATION/COMPANY: Johnson and Johnson, Inc.

ADDRESS: 501 George Street
New Brunswick, NJ 08903

TELEPHONE NUMBER: (201) 524-8206

SUBJECT OF CONVERSATION: Cost of production for commercial sterilization facilities

OAQPS AIR
DOCKET CONTROL ROOM

SUMMARY: *The ratio of the cost of sterilization to the total cost of production for the sterilized products is 3 percent.

*It is possible that smaller facilities would be affected by an increase in the cost of sterilization and would need to send products to contract facilities for sterilization.

*Cost for scrubber installation:

Capital costs: \$542,000

Operating costs: \$93,000

SIGNATURE: _____

CDM

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 5/7/87

Contacted by: Telephone

Company/Agency: Vacudyne Corporation
375 E. Joe Orr Road
Chicago Heights, Illinois 60411

Telephone Number: (312) 757-5200

Person(s) Contacted/Title(s)

Jerry Dzwierzynski, Project Engineer

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Dzwierzynski was contacted about the type of vacuum pump systems used by facilities that have Vacudyne condensation/reclamation units. He stated that Sterilization Services of Tennessee and Sterilization Services of California have closed-loop recirculation systems on their vacuum pumps. He does not know what type of vacuum pumps are used at other facilities that have the Vacudyne reclamation unit. Mr. Dzwierzynski said that if a facility is currently using a once-through water-sealed vacuum pump, the Vacudyne reclamation unit could easily handle the increase in flow if a closed-loop recirculation system were installed.

Mr. Dzwierzynski said that Vacudyne recommends that facilities purchasing the reclamation unit modify their vacuum pumps to use recirculating water. Vacudyne sells the materials required for this modification.

CONFIRMATION _____
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

A-88-03

II - E - 179

CONTACT REPORT--MRI Project No. 7723-K

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 3/13/87

Contacted by: Telephone

Company/Agency: Lederle Laboratories, Division
American Cyanamid Company
North Middletown Road
Pearl River, New York 10965

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AUG 2 1987

Telephone Number: (914) 735-5000

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Janet Regan, Environmental Engineer

CONTACT SUMMARY:

Ms. Regan was contacted for additional information about the ethylene oxide emission control device used at Davis & Geck, Division American Cyanamid Company in Manatu, Puerto Rico.

Ms. Regan provided the following information:

- the scrubber is used to control ethylene oxide stack emissions by "washing" the ethylene oxide with water to the drain.
- the 85 percent efficiency reported on the 1985 HIMA survey is the estimated amount of ethylene oxide that enters the drain.

- the chemical reaction of EtO and water produces ethylene glycol. The reaction is affected by contact time; we have no data regarding conversion.

DATE	Aug. 87
TIME	
BY	
REVIEWED	
VERIFIED	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

From: Vicki Soltis, Environmental Engineering Department

Date of Contact: July 8, 1987

Contacted by: Telephone

Company/Agency: John Zink Company
4401 South Peoria Avenue
Post Office Box 702220
Tulsa, Oklahoma 74170

Telephone Number: (918) 747-1371

Person(s) Contacted/Title(s)

Brian Duck, Engineer

CONFIRMATION REQUESTED 3/1/88

RECEIVED 3/9/88

NO REVISIONS

VERBAL ☒

CONTACT SUMMARY:

Mr. Duck was contacted for information about the use of flares to control emissions from sterilization processes that use ethylene oxide/carbon dioxide (EO/CO₂) gas mixtures. Mr. Duck stated that there are no problems associated with the use of flares and EO/CO₂ sterilants; however, safety precautions must be taken. The products of combustion would be CO₂, H₂O, and N₂; only a small amount of CO (ppm) would be produced. Flares are not recommended for use with EO/CFC-12 mixtures because of toxic by-products.

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AIR 2 1997

OPS AIR
DOCKET CONTROL ROOM

MIDWEST RESEARCH INSTITUTE

CONTACT REPORT -- MRI PROJECT NO. 8692-16

From: Martha E. Upchurch
Environmental Engineering Department

Date of Contact: July 24, 1987
(Revised August 18, 1987)

Contacted by: Telephone

Company/Agency: Radiation Sterilizers, Inc.
3000 Sand Hill Road - 4-245
Menlo Park, California 94025

Telephone: 415/854-2800

Contact/Title: Mr. Allan Chin, President

RECEIVED
AUG 26 1997
OAGPS AIR
DOCKET CONTROL ROOM

Mr. Chin discussed the gamma radiation (GR) process, applications, market history and trends, and costs. He also compared GA with ethylene oxide (EO) and beta electron sterilization techniques.

The source of GR is cobalt 60 or cesium-137. The material is housed in a concrete radiation cell that is 6 to 6-1/2 feet thick. These rooms typically are free standing or located within a large manufacturer's facility.

The product is transported by conveyor into the radiation room, is exposed uniformly to the rays, and then is transported out of the room. The gamma rays do not leave any residual in the product; thus, the material is immediately available for use. The amount of radiation applied is controlled by the speed of the conveyor and the amount of isotope in the room.

Gamma radiation became commercially viable in 1978 as a result of EPA's announcement of the mutagenicity of EO. Since that time, industry growth has fluctuated: growth was slow from 1978 to 1980, and rapid from 1981 to 1983. The years 1983 to 1985 were down because the supply of cobalt in Canada (supplier to the U.S. gamma radiation industry) ran out. With adequate cobalt supply since 1985, the industry has experienced rapid growth. Mr. Chin indicated that, having "learned its lesson," Canadian suppliers of cobalt will not permit another shortage.

Mr. Chin estimates that about 50 percent of the market currently is using GR and that 70 to 80 percent will be doing so within the next 3 to 4 years, a rapid conversion for an industry considered to be conservative. From 50 to 60 percent of the contract sterilization market uses GR.

Gamma radiation is more economical than EO sterilization. Costs for GR are based on units of cubic feet (ft³) of product and are determined by the amount of radiation needed; that is, by the level of contamination. A rule of thumb would be a range of \$.60/ft³ for 1 million rads to \$1.20/ft³ for 2-1/2 million rads applied.

Gamma radiation capacity is now adequate for industry needs. Mr. Chin estimates that currently there is GR capacity available such that no new facilities would need to be constructed for the next 5 years and the 70 to 80 percent of the market mentioned above that will be using GR within the next 3 to 4 years can be accommodated. Users of EO protested regulation on the basis that they would be put out of business because there was no alternative to EO use. However, the EPA, OSHA, and the FDA now are able to regulate EO more strictly because GR is available in sufficient capacity.

Products that may be sterilized by GR include all disposable medical devices (e.g., plastic, fabrics) that go into an operating room in a hospital.* Mr. Chinn mentioned two or three compounds, Teflon, some poly-propylene, and acetyl delrin, that cannot withstand GR. The FDA prohibits GR sterilization of any products containing alcohol. Because use of EO is such a problem, hospitals are purchasing ready-to-use kits for certain procedures (e.g., tracheotomy). Some of these kits may contain alcohol swabs. The plastics industry is making its products radiation stable and many are now available. Mr. Chin noted the many more ads in trade journals for stable plastic products compared to the few in past years. The packaging industry also is working to develop products that withstand GR.

In addition to medical supplies and devices, GR is used on commercial products (infant toys, clean room garments), cross-linking plastics, cosmetics, composite wood flooring, and food packaging (milk cartons, cream containers). Gamma radiation also is used for food irradiation and gem enhancement.

In the absence of EO and/or CFC regulation, current users will stay with EO because they have the equipment and it is paid for. However, much of this equipment is antiquated and, thus, dangerous (e.g. leaks). These users will be slow to switch to GR. If EO and/or CFC are regulated, the impact on the GR industry would depend on the level of regulation. An outright EO ban would mean rapid growth. Mr. Chin estimates that 75 to 80 percent of the contract sterilization market would be using GR in 1 to 1-1/2 years under a tight EO and/or CFC regulation.

The GR industry is strictly regulated. It is governed by the NRC or an authorized State agency, and FDA and OSHA regulations also must be complied with. The industry is constantly monitored, and licensing by the NRC can take from 6 to 12 months after detailed reports are filed. Mr. Chin offered a challenge for anyone to detect an unsafe level of radiation in RSI facilities and said that there is no risk of worker exposure.

Mr. Chin explained that beta radiation is machine generated, very high energy, very rapid radiation. The dosage that beta can accomplish in seconds may take GR as long as 24 hours. However, at 1 million electron volts, GR will penetrate 5 to 6 feet of water easily; beta cannot penetrate even 1 inch of water at that voltage. Thus, the difference between the two methods concerns speed and depth of penetration. For another example, Mr. Chin said that beta can sterilize thin, small items (one pair of gloves) very, very quickly, but gamma can handle an entire carton of gloves. Mr. Chin believes that GR offers greater customer satisfaction, flexibility, and economy.

Mr. Chin was extremely cooperative and patient during this lengthy conversation. His comments and information are valuable contributions to the project.

August 18, 1987: Revised per Mr. Chin's comments.

CONFIRMATION	8/18/87
RESPONSE	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

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CONTACT REPORT--MRI Project No. 869216-K

A-88-03

II - E - 182

From: Gail Taylor, Environmental Engineering Department

Date of Contact: 7/31/87

Contacted by: Telephone

Company/Agency: Linde Division of Union Carbide Corporation
100 Davidson Avenue
Post Office Box 6744
Somerset, New Jersey 08873

Telephone Number: (201) 271-2618

Person(s) Contacted/Title(s)

Steve Conviser, Business Manager and Chip Woltz, Product Manager

CONFIRMATION	8/17/87
RESPONSE	
RECEIVED	
WRITTEN <input checked="" type="checkbox"/>	1997
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	
O-QPS AIR DOCKET CONTROL ROOM	

CONTACT SUMMARY:

I called Mr. Woltz to inquire about operating pressures and the feasibility of substituting Carboxide™ (10/90 EO/CO₂) in existing Oxyfume™ 12 (12/88 EO/CFC-12) chambers. He agreed to answer my questions with the assistance of Mr. Conviser, his supervisor.

Mr. Woltz stated that most sterilization cycles using pure ethylene oxide (EO) operate at a pressure below 1 atm, approximately 10 psia. Different sterilization cycles using combinations of EO and nitrogen or carbon dioxide (CO₂) could operate at higher pressures. The operating pressures for Oxyfume™ 12 cycles range between 10 to 13 psig depending on the depth of the prevacuum. The few sterilizers that use Carboxide™ operate at approximately 30 psig.

Mr. Woltz stated Carboxide™ requires high operating pressures to ensure that a high concentration of EO penetrates the products. Unlike Oxyfume™ 12, which is 27.3 percent EO by volume, Carboxide™ is 10 percent by volume. Carboxide™ is shipped at 750 psig and 70°F due to the high vapor pressure of CO₂.

Mr. Woltz and Mr. Conviser agreed that substituting Carboxide™ in existing Oxyfume™ 12 chambers and operating these chambers at their design pressures (approximately 15 psig) for longer exposure times was feasible. However, both gentlemen voiced the following concerns over the effectiveness of this substitution.

First, Mr. Conviser assumes that since Oxyfume™ 12 has 2.5 to 3 times the amount of EO as Carboxide™, the product exposure time would be 2.5 to 3 times longer at the Oxyfume™ 12 operating pressure. Mr. Conviser stated that the substitution would require revalidation for each product to check EO concentration levels and determine new exposure time to ensure sterilization. He stated that many industries operate their sterilization chambers constantly. An increase in exposure time would decrease the throughput by 50 to 60 percent, making the substitution prohibitive.

CFC11-2/1

Second, Mr. Woltz stated that chamber replacement would be required if Carboxide™ was used at 30 psig. The existing chambers are not ASME vessels and are not designed to operate at that pressure.

Third, the piping from the cylinder to the chamber would require replacement to accommodate the 750 psig from the Carboxide™ container. The current piping is typically rated at 150 to 250 psig.

Fourth, both gentlemen voiced concerns over the retraining of personnel to handle the higher pressurized containers. Mr. Conviser stated that hospital sterilization chambers are typically operated by nontechnical personnel, and accidents occur despite the training these personnel receive. Both gentlemen agreed that the potential safety problems (increase in accidents and injuries) and the retraining would require a "phenomenal" effort from both suppliers, manufacturers, and hospitals.

Fifth, Mr. Woltz stated it is difficult to maintain the concentration of the 10/90 mixture of Carboxide™ as it is withdrawn from the cylinder. Oxyfume™, however, maintains a constant concentration during this process. Fumigation procedures can tolerate a variation in concentration; sterilization procedures cannot. Mr. Conviser stated that the reject rate (devices rejected due to unsterilization) maybe higher when Carboxide™ is used because of this variation in concentration.

Sixth, Mr. Woltz discussed the added expense of shipping Carboxide™ as compared to Oxyfume™ 12. When shipping Oxyfume™ 12 packages, about 9 percent of the gross weight is EO. With Carboxide™, only about 3 percent of the gross weight is EO.

Mr. Conviser concluded that the conversions required to substitute Carboxide™ for Oxyfume™ would be costly and would pose a potential for safety problems. Mr. Conviser stated that less than 1 percent of the company's business involved Carboxide™. Carboxide™ is supplied as a special service.

Mr. Woltz stated that although he was unaware of any specific hospital that uses Carboxide™, a hospital using older sterilization chambers could employ Carboxide™.

Mr. Woltz confirmed that a 90/10 (90 percent EO and 10 percent CO₂) mixture would be flammable. Such a mixture would be treated the same as pure EO with regard to flammability.

Mr. Woltz stated that all products exposed to either pure EO or Carboxide™ would require a design verification to ensure tolerance of either deep vacuums (>29 in. mercury) or high pressures, respectively. The products would require >29 in. Hg vacuum design modifications to withstand these variations. Each product would require individual research and testing to assure tolerance.

Mr. Conviser and Mr. Woltz agreed to allow the use of figures presented in Linde/Union Carbide's Gas Sterilants brochure on pages 8 and 9 in an Ethylene Oxide Background Information Document being prepared by the U. S. Environmental Protection Agency. These figures would be appropriately referenced.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact:

RECEIVED

Contacted by: Telephone

AUG 2 8 1997

Company/Agency: Cobe Laboratories
1185 Oak Street
Lakewood, Colorado 80215

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (303) 232-6800

Person(s) Contacted/Title(s)

Ms. Vera Buffaloe, Director, Regulatory Affairs

CONTACT SUMMARY:

Ms. Buffaloe provided the following information in regards to ethylene oxide (EO) usage at the above listed facility:

1. EO sterilization usage: Yes
2. Purpose: Sterilization of medical devices
3. Type device: Vacudyne
4. EO consumption: Call Mike Baird, Mgr. at later date, ext. 4337

CONTACT REPORT--MRI Project No. 8692-K

From: Calvin L. Green, Environmental Engineering Department

Date of Contact:

Contacted by: Telephone

Company/Agency: The John Hopkins Hospital
2021 East Monument Street
Baltimore, Maryland 21205

Telephone Number: (301) 955-5918

Person(s) Contacted/Title(s)

Dr. Robert B. Olcerst, Environmental Health Officer

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Dr. Olcerst provided the following information in regards to EO emission control devices for hospital EO sterilizers. Dr. Olcerst indicated that the hospital has three EO sterilizers that do not have EO emission control devices. He did provide information pertaining to companies that manufacture EO control devices. These companies were MSA, that markets a catalytic oxidation converter, and Damas, a scrubber process, and exhaust systems sold by numerous manufacturers that dilute EO emissions while in the gas stream. The capital cost of a device that removes EO from the gas stream can be rather cost prohibitive.

CONTACT REPORT--MRI Project No. 8692-K

A-88-03

BILL

BRUCE
II E 185

From: Al Meiners, Environmental Systems Department

Date of Contact:

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: U. S. Environmental Protection Agency
AEERL
Research Triangle Park, N.C.

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (919) 541-7653

Person(s) Contacted/Title(s)

Chuck Darwin, Physical Scientist, Project Officer

CONTACT SUMMARY:

Chuck called John McDonough at MSA concerning their need for payment to come down and describe their system. He told them that we were also planning tests of other companies' equipment and that we had no money for ~~Travel~~ ^{Travel} or to pay consultants (back him up on this).

Chuck thinks that the problem is solved and that they will cooperate with us. John will call Chuck to verify this when they both return on August 4.

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 10/11/85

Contacted by: Telephone

Company/Agency: Duke University Medical Center
Durham, North Carolina

Telephone Number: (919) 681-4283

Person(s) Contacted/Title(s)

Mr. Bill Dennis

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Dennis was contacted to request and coordinate a visit to the Medical Center's ethylene oxide sterilizer. Mr. Dennis indicated that the medical center operates five EO sterilizers. During the period October 21 to November 1, 1985, the hospital would be going through a period of remodeling and renovation. The hospital staff will be in the process of moving and could not accommodate a survey team during the period. A more appropriate time would be after November 15, 1985.

C. Green, MRI, to B. Dennis, Duke University
Medical Center. ^{October 5} ~~November 11~~, 1985. Telecon:

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 10/11/85

Contacted by: Telephone

Company/Agency: Rex Hospital
4420 Lake Boone Drive
Raleigh, North Carolina 27607

Telephone Number: 919/755-3100

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Mr. Jim Whither, Hospital Administrator
Mr. Stuart Word, Director SPD

CONTACT SUMMARY:

Visited Rex Hospital and conducted an informal meeting with Mr. Whither and Mr. Word to discuss the hospital's ethylene oxide sterilizer. The hospital has one EO sterilizer in the SPD department which is operated once per day. The unit is operated by trained technicians. The unit does have some type of emission control device. Consumption of EO is approximately 3 bottles per month. The unit has met all OSHA Health and Safety requirements to operate an ethylene oxide sterilizer. Coordinated to tentatively survey the sterilization chamber on October 31, 1985.

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 10/15/85

Contacted by: Telephone

RECEIVED

Company/Agency: Castle, Division of Sybron Corporation
1777 East Henrietta Road
Rochester, New York 14692

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (716) 475-1400

Person(s) Contacted/Title(s)

Mr. Brad Tomazewski

CONTACT SUMMARY:

Mr. Tomazewski was contacted to provide information in regards to ethylene oxide sterilizers. Castle does manufacture and distribute EO sterilizers and emission control devices. Information must be requested by written request.

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: 10/15/85

Contacted by: Telephone

Company/Agency: Vernitron Medical Products
Five Empire Boulevard
Carlstadt, New Jersey 07072

RECEIVED

AUG 26 1997

Telephone Number: 1-800-631-1365

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Mr. Cosmos Dibede, National Sales Manager

CONTACT SUMMARY:

Mr. Dibede was contacted to provide information in regards to ethylene oxide sterilizers and EO emissions. Vernitron manufactures and sells sterilizers of all sizes. He suggested contacting the American Hospital Association to get a list of hospitals, thus hospital users of EO. Mr. Dibede will send literature relevant to the ethylene oxide sterilizers manufactured by Vernitron.

CONTACT REPORT--MRI Project No. 7712-L

A-88-03
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II E 190

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 10/16/85

Contacted by: Telephone

Company/Agency: NIEHS
Research Triangle Park, North Carolina 27709

RECEIVED

AUG 26 1997

Telephone Number: (919) 541-3345

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Dr. John DeMence, Health and Safety Engineer

CONTACT SUMMARY:

Dr. DeMence was contacted to determine whether the NIEHS Research Facilities used ethylene oxide sterilizers. He stated that the research facility used no ethylene oxide sterilizers. They have not been used in about 3 years due to more stringent OSHA regulations and environmental risks.

From: Calvin Green, Environmental Engineering Department

Date of Contact: 10/25/85

Contacted by: Telephone

Company/Agency: AMSCO
Richmond, Virginia

Telephone Number: 1-800-446-3012

Person(s) Contacted/Title(s)

Mr. Wayne Lennon, Service Manager

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Wayne Lennon was contacted to ascertain information in regards to AMSCO ethylene oxide sterilizers at Wake County Medical Center and North Carolina Memorial Hospital. Mr. Lennon provided the following information:

Wake Medical Center:

2 AMSCO ethylene oxide sterilizers

Medalion Model

Dimensions: 24" x 36" x 48"

24" x 36" x 60"

1 Envirogard fan ventilation system

Design exhaust flow: 550 cfm

North Carolina Memorial Hospital:

4 AMSCO ethylene oxide sterilizers

Medalion Model

Dimensions: 2 @ 20" x 20" x 38"

2 @ 24" x 36" x 60"

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 5, 1985

Contacted by: Telephone

Company/Agency: LA City - USC Medical Center
1200 N. State Street
Los Angeles, California 90023

RECEIVED

AUG 23 1997

Telephone Number: (213) 226-6445

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Mr. Roy Sheridan, Building Crafts Manager

CONTACT SUMMARY:

Mr. Sheridan was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Mr. Sheridan provided the following information:

EO use: yes No. of EO sterilizers: 10

Manufacturer: AMSCO, Castle, 3M Model No. see attachment

Chamber dimensions (in.): see attachment

Sterilizer gas mixture: (% EO) 12 (% 88) Freon

EO Consumption per unit (lb):

(month) 6 cylinder

(year) 72

Total gas consumption (lb): 10,080

EO storage: cylinder

Location: behind large sterilizers

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 2/day per sterilizer

Sterilizer vent:

Localized area: 4

Always intact: Is area enclosed: 4, 7 exposed in laboratory area

Drain:

Gas/water separator yes

Is process equipped with an EO emission control device: 1

Type: Envirogard Fan System

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes

Employee monitoring program: yes

Attachment

Ethylene oxide sterilizers

AMSCO 3

1 24 in x 36 in x 60 in
1 20 in x 20 in x 36 in
1 20 in x 20 in x 38 in

Castle 4

2 24 in x 36 in x 60 in
1 20 in x 20 in x 38 in
1 16 in x 16 in x 36 in

3M Portables* 3

3 12 in x 12 in x 18 in

*Portable use pure ethylene oxide. Storage is in ampules and emissions are released in work area.

CONTACT REPORT--MRI Project No. 7712-L

II E 193

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: November 6, 1985

Contacted by: Telephone

RECEIVED

Company/Agency: Castle
Division of Sybron Corporation
Post Office Box 492
Garner, North Carolina 27529

AUG 26 1987

QAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (404) 448-9499

Person(s) Contacted/Title(s)

Mr. Bill Collins, Technical Specialist

CONTACT SUMMARY:

Mr. Collins was contacted to secure information pertinent to the gas separator used on the Castle ethylene oxide sterilizers. The gas separator is used to condense the sterilizer gas after the sterilization cycle is complete. The water vapor is condensed thus forming water and discharged through a water drain. Remaining gases are vented out through the side of the housing system.

Mr. Collins also indicated that EPA provided considerable input into the design of the gas separator.

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CONTACT REPORT--MRI Project No. 7712-L

II E 194

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: November 11, 1985

Contacted by: Telephone

Company/Agency: Local Temporary Services
Contractors

Telephone Number:

Person(s) Contacted/Title(s)

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Local temporary services contractors were contacted to determine the cost of employing data entry services. Seven firms were contacted with five responding. Prices based upon the type work and equipment utilization ranged from \$6.75 to \$8.90 per hour. Average cost was \$7.52 per hour.

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: November 12, 1985

Contacted by: Telephone

Company/Agency: Castle, Division of Sybron
Post Office Box 23077
Rochester, New York 14692

Telephone Number: (716) 272-5123

Person(s) Contacted/Title(s)

Mr. Chip Moore, Manager, Product Support

CONFIRMATION	RECEIVED
RESPONSE	AUG 26 1997 Dec 4, 1985
OAPS/AIR DOCKET CONTROL ROOM	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Moore telephoned and provided the following information in regards to Castle ethylene oxide sterilizers. Several models are manufactured by Castle. The newer models are equipped with a water ejector. A considerable amount of sterilizer gas is entrained in the water vapor from the chamber. Approximately 50 to 70 percent of the gas is discharged down the drain.

Older EO sterilizers remove EO from the sterilizer chamber by using a vacuum pump. A considerable amount of sterilizer gas goes down the drain and a substantial amount is emitted into the rear access area around the drain. The gas separator was made available, to older EO sterilizer users to provide a means to vent the amount of sterilizer gas emitted through the stack to the roof. The gas separator is offered to the customer as a method to reduce EO vapors. A considerable amount of sterilizer gas is still discharged down the drain. It may be necessary to add local exhausts to the drain.

Castle offers as standard, a door exhaust hood and drain box, and requires the customer to provide a specified exhaust flow rate (cfm) and make appropriate connections to the unit when installing new EO sterilizers.

Mr. Moore will send literature on Castle EO sterilizers and gas separators.

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: November 13, 1985

Contacted by: Telephone

RECEIVED

Company/Agency: Data Processing Companies

AUG 26 1997

Telephone Number:

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

CONTACT SUMMARY:

Several computer data processing firms were contacted to acquire estimates for entering data from a computer printout to a computer tape. An indepth price estimate was acquired from one firm, Hydra Computer Corporation. Costs dependent upon the number of character inputs and the actual procedures necessary would range from \$3,900 to \$11,000. Cost per entry would range from \$0.15 to \$0.20. Without accuracy verification, accuracy would be about 95 percent. Rekey verification would give accuracy to 99.75 percent but would cost twice as much. To give a firm estimate, the actual data would have to be reviewed first.

The contact person at Hydra Computer Corporation is Carolyn Bell at (919) 828-9226.

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 19, 1985

Contacted by: Telephone

Company/Agency: Baylor University Medical Center
3500 Gaston Avenue
Dallas, Texas 75246

Telephone Number: (214) 820-3267

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OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Mr. Roland Schriever, Manager, Supply Distribution

CONTACT SUMMARY:

Mr. Schriever was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Mr. Schriever provided the following information:

EO use: yes No. of EO sterilizers: two

Manufacturer: AMSCO Model No. Medallin

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (% 88) Freon

EO Consumption per unit (lb):

(month) 4 cylinders

(year) 48 cylinders

Total gas consumption (lb): 6,480

EO storage: yes Location: separate area

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 2

Sterilizer vent: dedicated

Localized area: yes

Always intact: yes

Is area enclosed: yes

Drain:

Gas/water separator yes

Is process equipped with an EO emission control device: yes

Type: Envirogard Fan System

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: yes, 3M badge and AMSCO
Analyzer for local area

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 20, 1985

Contacted by: Telephone

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Company/Agency: Bellevue Hospital Center
1st Avenue and 27th
New York, New York 10016

AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOM

Telephone Number: (212) 561-6521

Person(s) Contacted/Title(s)

Mr. M. James

CONTACT SUMMARY:

Mr. James was contacted to provide information pertaining to ethylene oxide consumption at large surgical hospitals. Mr. James provided the following information:

EO use: yes No. of EO sterilizers: three

Manufacturer: AMSCO

Model No.

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (% 88) Freon

EO Consumption per unit (lb):

(month) 12 cylinders

(year) 144 cylinders

Total gas consumption (lb): 218,700

EO storage: cylinder

Location: behind sterilizers

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 1/day

Sterilizer vent:

Localized area:

Always intact:

Is area enclosed: yes

Drain:

Gas/water separator:

Is process equipped with an EO emission control device: yes

Type: don't know what type

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm)

Aerator used: yes

Employee monitoring program: yes

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 20, 1985

Contacted by: Telephone

Company/Agency: Johns Hopkins Hospital
600 N. Wolfe Street
Baltimore, Maryland 21205

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AUG 26 1997

Telephone Number: (301) 955-5918

OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Dr. Robert Olcerost, Environmental Health Officer

CONTACT SUMMARY:

Dr. Olcerost was contacted to provide information pertaining to ethylene oxide consumption at large surgical hospitals. Mr. James provided the following information:

E0 use: yes No. of E0 sterilizers: 4 (one portable)

Manufacturer: 3 Castle, 1 3M Model No.

Chamber dimensions (in.): 2 @ 26 x 62 x 76; 20 x 20 x 36

Sterilizer gas mixture: (% E0) 12 (% 88) Freon

E0 Consumption per unit (lb):

(month) 15 cylinders (year) 180 cylinders

Total gas consumption (lb): 24,300

E0 storage: cylinder Location: behind sterilizers

E0 costs: per load _____ per month _____ per year _____

Sterilizer use per day: 4/day per unit (except portable)

Sterilizer vent: one dedicated to the 3 Castle Localized area: yes

Always intact: yes Is area enclosed: yes Portable: E0 (100%) in 70 s

Drain:

Gas/water separator: yes

Is process equipped with an E0 emission control device: yes

Type: Venturi liquid separator and ventilation capture

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes

Employee monitoring program: yes

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 20, 1985

Contacted by: Telephone

Company/Agency: Massachusetts General Hospital
32 Fruit Street
Boston, Massachusetts 02114

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Telephone Number: (617) 726-2000

OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Ms. Agnes Flaherty, CSR Manager

CONTACT SUMMARY:

Ms. Flaherty was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Flaherty provided the following information:

EO use: yes No. of EO sterilizers: 3 (2 portables)

Manufacturer: 1 AMSCO, 2 3M Model No.

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

Sterilization Period: 4 1/2 hours Portable: 100% EO

EO Consumption per unit (lb):

(month) 20 cylinders; 32 cartridges (year) 240 cylinders

Total gas consumption (lb): 32,400

EO storage: cylinder & cartridge Location: behind sterilizer

EO costs: per cylinder: \$167.00 per cartridge: \$1.20 per year _____

Sterilizer use per day: AMSCO 4/day portable 8/day

Sterilizer vent: dedicated Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an EO emission control device: yes

Type: Envirogard Fan System

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: no

Aeration period: 15 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 21, 1985

Contacted by: Telephone

Company/Agency: Mt. Sinai Hospital
One Gustave L. Levy Place
New York, New York 10029

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Telephone Number: (212) 650-6500

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Mr. Ronald Thompson, Supervisor, Central Supply

CONTACT SUMMARY:

Mr. Thompson was contacted to provide information pertaining to ethylene oxide use and consumption. Mr. Thompson provided the following information:

EO use: yes No. of EO sterilizers: 1

Manufacturer: AMSCO

Model No.

Chamber dimensions (in.): 24 X 36 X 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb):

(month) 4 cylinder

(year) 48 cylinder

Total gas consumption (lb): 6,480

EO storage: cylinder

Location: behind sterilizer

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 2 to 3/day

Sterilization period: 2 1/2 hours

Sterilizer vent: dedicated

Localized area: yes

Always intact: yes

Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an EO emission control device: No

Type:

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes

Employee monitoring program: yes

Aeration period: 16 hours

From: Calvin Green, Environmental Engineering Department

Date of Contact: November 21, 1985

Contacted by: Telephone

Company/Agency: Society of New York Hospital
525 East 68th Street
New York, New York 10021

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Telephone Number: (212) 472-8054

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Mr. Bud Gordon, Central Sterile Supply Manager

CONTACT SUMMARY:

Mr. Gordon was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Mr. Gordon provided the following information:

EO use: yes No. of EO sterilizers: 1

Manufacturer: AMSCO

Model No. 2864PF

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb):

(month) 1/3 cylinder (year) 4

Total gas consumption (lb): 540

EO storage: cylinder

Location: behind sterilizer

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 1/day (7 days) Sterilization period: 2 1/2 hours

Sterilizer vent: dedicated

Localized area: no

Always intact: yes

Is area enclosed: no

Drain:

Gas/water separator: ?

Is process equipped with an EO emission control device: No

Type:

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: No

Aeration Period: 12 1/2 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Cecily Beall, Environmental Engineering Department
Date of Contact: 11/25/85
Contacted by: Telephone
Company/Agency: Plant Protection Institute
Agricultural Research Service
USDA
Beltsville, Maryland
Telephone Number: (609) 292-3976

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DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Dave Knox

CONTACT SUMMARY:

Mr. Knox is part of the Fumigant Assessment Team. He just completed a survey of all 50 States on use of EO for fumigation of beehives. Only 12 States use EO for this purpose. Eleven of the States use the mobile EO chamber made by Miskoe. New Jersey has a stationary EO chamber for beehive fumigation. Mr. Knox will send me a copy of the draft report on the 12 States that fumigate beehives.

The author of the USDA report "Assessment of Ethylene Oxide Uses in Agriculture" was Ken Havel. Mr. Knox is not sure if Mr. Havel is still with USDA. The phone number of the part of USDA for which Mr. Havel worked at the time of the report is (201) 659-9099.

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 3, 1985

Contacted by: Telephone

Company/Agency: Baptist Memorial Hospital
 Central Supply
 899 Madison Avenue
 Memphis, Tennessee 38146

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AUG 2 1997

Telephone Number: (901) 522-5094

OAQPS AIR
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Person(s) Contacted/Title(s)

Ms. Zane Heavener, Supervisor

CONTACT SUMMARY:

Ms. Heavener was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Heavener provided the following information:

EO use: yes **No. of EO sterilizers:** 1

Manufacturer: AMSCO

Model No.

Chamber dimensions (in.): 24 x 36 x 48

Sterilizer gas mixture: (% EO) 12 **(%88) Freon**

EO Consumption per unit (lb): (month) 4 cylinder **(year)** 48

Total gas consumption (lb): 6,480

EO storage: cylinder

Location: adjacent on side wall

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 1/day (7 days) **Sterilization period:** 1.75 hours

Sterilizer vent: yes

Localized area: yes

Always intact: yes

Is area enclosed: yes

Drain:

Gas/water separator:

Is process equipped with an EO emission control device:

Type:

Diameter of stack/vent: _____ (in.) **Ht. above roof:**

Average flow rate during discharge (acfm):

Aerator used: yes

Employee monitoring program: yes

Aeration period: 12 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 3, 1985

Contacted by: Telephone

Company/Agency: Barnes Hospital
Central Services
Barnes Hospital Plaza
St. Louis, Missouri 63110

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DOCKET CONTROL ROOM

Telephone Number: (314) 362-5000

Person(s) Contacted/Title(s)

Ms. Fern Bridgeforth, Director, Central Services

CONTACT SUMMARY:

Ms. Bridgeforth was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Bridgeforth provided the following information:

EO use: yes No. of EO sterilizers: 2

Manufacturer: Getinge Model No.

Chamber dimensions (in.): did not know (medium)

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 12 cylinders (year) 144

Total gas consumption (lb): 19,440

EO storage: cylinder Location: remote storage area

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 3/day (7 days) Sterilization period:

Sterilizer vent: yes Localized area: no

Always intact: yes Is area enclosed: no

Drain:

Gas/water separator:

Is process equipped with an EO emission control device: yes

Type: ?

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: yes, 3M badges

Aeration period:

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 3, 1985

Contacted by: Telephone

Company/Agency: James M. Jackson Memorial Hospital
1611 N.W. 12th Avenue
Miami, Florida 33136

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Telephone Number: (305) 549-6806

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Person(s) Contacted/Title(s)

Ms. Mary Larkin, Quality Assurance Supervisor

CONTACT SUMMARY:

Ms. Larkin was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Larkin provided the following information:

EO use: yes No. of EO sterilizers: 1

Manufacturer: AMSCO

Model No.

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 1 cylinder (year) 12

Total gas consumption (lb): 1,620

EO storage: cylinder

Location: behind sterilizer

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: once

Sterilization period:

Sterilizer vent: yes

Localized area: yes

Always intact: yes

Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an EO emission control device: yes

Type: Envirogard fan system

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes (2) Employee monitoring program: yes, 3M film badge

Aeration period:

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 4, 1985

Contacted by: Telephone

Company/Agency: Cleveland Clinic Hospital
Central Services
9500 Euclid Avenue
Cleveland, Ohio 44103

Telephone Number: (213) 444-2450

Person(s) Contacted/Title(s)

Ms. Eleanor Riley, Manager, Central Services

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CONTACT SUMMARY:

Ms. Riley was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Riley provided the following information:

EO use: yes No. of EO sterilizers: 4 and 3 portable

Manufacturer: Castle, 3M Model No.

Chamber dimensions (in.): 24 x 36 x 60 (Castle)

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) ? (year)

Total gas consumption (lb):

EO storage: cylinder Location:

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: continuously Sterilization period: 5 hours

Sterilizer vent: yes Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an EO emission control device: yes

Type: ?

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes (6) Employee monitoring program: yes, film badge, gas analyzer

Aeration period: 2 to 48 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 4, 1985

Contacted by: Telephone

Company/Agency: Kings County Hospital Center
Central Services
451 Clarkson Avenue
Brooklyn, New York 11203

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Telephone Number: (718) 735-3493

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Ms. Gloria Boone, Administrative Aid, Central Services

CONTACT SUMMARY:

Ms. Boone was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Boone provided the following information:

EO use: yes No. of EO sterilizers: 1

Manufacturer: AMSCO Model No.

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 3 cylinders (year) 36

Total gas consumption (lb): 4,860

EO storage: cylinder Location: remote area

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 3/5 days Sterilization period: 2 hours

Sterilizer vent: yes Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: ?

Is process equipped with an EO emission control device: yes

Type: ?

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: yes, gas monitoring
program; 3M film badges

Aeration period: 8 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 4, 1985

Contacted by: Telephone

Company/Agency: Methodist Hospital of Indiana
Central Supply
1604 N. Capitol Avenue
Indianapolis, Indiana 46206

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O&OPS AIR
CONTROL ROOM

Telephone Number: (317) 924-6411

Person(s) Contacted/Title(s)

Mr. Ron Good, Technical Assistant

CONTACT SUMMARY:

Mr. Good was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Mr. Good provided the following information:

E0 use: yes No. of E0 sterilizers: 1

Manufacturer: Castle

Model No.

Chamber dimensions (in.): 26 x 62 x 76

Sterilizer gas mixture: (% E0) 12 (%88) Freon

E0 Consumption per unit (lb): (month) 12-15 cylinders (year) 180

Total gas consumption (lb): 24,300

E0 storage: cylinder

Location: behind sterilizer

E0 costs: per load _____ per month _____ per year _____

Sterilizer use per day: 2-3/5 days Sterilization period: 4 hours

Sterilizer vent: yes

Localized area: yes

Always intact: yes

Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an E0 emission control device: yes

Type: kit by Castle

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes (2) Employee monitoring program: yes, badge, American
E0 scanner

Aeration period: 6 to 30 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 4, 1985

Contacted by: Telephone

Company/Agency: Wilmington Medical Center
Central Processing
501 W. 14th Street
Wilmington, Delaware 19899

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OAGPS AIR
DOCKET CONTROL ROOM

Telephone Number: (302) 733-1000

Person(s) Contacted/Title(s)

Ms. Darla Diggins, Supervisor, Central Processing

CONTACT SUMMARY:

Ms. Diggins was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Diggins provided the following information:

EO use: yes No. of EO sterilizers: 2

Manufacturer: AMSCO

Model No.

Chamber dimensions (in.): 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 4 cylinders (year) 48

Total gas consumption (lb): 6,480

EO storage: cylinder

Location: behind sterilizer

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 1/7 days

Sterilization period: 1 hour

Sterilizer vent: yes

Localized area: yes

Always intact: yes

Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an EO emission control device: yes

Type: Envirogard fan system

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes (3) Employee monitoring program: yes, 3M film badges

Aeration period: 12 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 5, 1985

Contacted by: Telephone

Company/Agency: Charity Hospital of Louisiana
Central Supply Processing
1532 Tulane Avenue
New Orleans, Louisiana 70140

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DOCKET CONTROL ROOM

Telephone Number: (504) 568-2311

Person(s) Contacted/Title(s)

Ms. Mary Picot, CMS Worker 1

CONTACT SUMMARY:

Ms. Picot was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Picot provided the following information:

EO use: yes No. of EO sterilizers: 3

Manufacturer: ? Model No.

Chamber dimensions (in.):

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 17 cylinders (year) 204

Total gas consumption (lb): 27,540

EO storage: cylinder Location: 2 remote, 1 behind

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 1, 2/day; 2 continuously Sterilization period: 5 hr

Sterilizer vent: yes Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: ?

Is process equipped with an EO emission control device: ?

Type: ?

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: no

Aeration period: 12 to 48 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 5, 1985

Contacted by: Telephone

Company/Agency: Rush-Presbyterian-St. Lukes Med. Center
OR/SPD
6130 N. Sheridan Road
Chicago, Illinois 60660

Telephone Number: (312) 942-5298

Person(s) Contacted/Title(s)

Ms. Marilyn Lenick, Manager, OR/SPD

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CONTACT SUMMARY:

Ms. Lenick was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Ms. Lenick provided the following information:

EO use: yes No. of EO sterilizers: 3

Manufacturer: AMSCO Model No. 2 Eagles, 1 Medallion

Chamber dimensions (in.): ?

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb):

(month) 14 (year) 168

Total gas consumption (lb): 22,680

EO storage: cylinder Location: remote area/1 behind

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 4/7 days Sterilization period: 2 hours 20 min.

Sterilizer vent: yes Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: no

Is process equipped with an EO emission control device: yes

Type: Envirogard

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: yes, AMSCO film badge

Aeration period: 12 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 5, 1985

Contacted by: Telephone

Company/Agency: St. Mary's Hospital of Rochester
Sterile Processing
1216 2nd Street S.W.
Rochester, Minnesota 55902

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DOCKET CONTROL ROOM

Telephone Number: (507) 285-6528

Person(s) Contacted/Title(s)

Mr. Dick Casper, Supervisor, Sterile Processing

CONTACT SUMMARY:

Mr. Casper was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Mr. Casper provided the following information:

EO use: yes No. of EO sterilizers: 1/1 being installed

Manufacturer: Vernitron/Castle 24 x 48 x 60 Model No.

Chamber dimensions (in.):

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 8 cylinders (year) 96

Total gas consumption (lb): 12,960

EO storage: cylinder Location: remote

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 2/7 days Sterilization period: 5 1/2 hours

Sterilizer vent: yes Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: ?

Is process equipped with an EO emission control device: no

Type:

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: yes, film badge

Aeration period: 12 hours

CONTACT REPORT--MRI Project No. 7712-L

From: Calvin Green, Environmental Engineering Department

Date of Contact: December 5, 1985

Contacted by: Telephone

Company/Agency: University of Iowa Hospital and Clinics
650 Newton road
Central Sterilization Services
Iowa City, Iowa 52242

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DOCKET CONTROL ROOM

Telephone Number: (319) 356-1616

Person(s) Contacted/Title(s)

Mr. Mike Murphy, Supervisor, Central Sterilization Services

CONTACT SUMMARY:

Mr. Murphy was contacted to provide information pertaining to ethylene oxide use and consumption at large surgical hospitals. Mr. Murphy provided the following information:

EO use: yes No. of EO sterilizers: 3

Manufacturer: AMSCO Model No.

Chamber dimensions (in.): 1 @ 20 x 20 x 48; 2 @ 24 x 36 x 60

Sterilizer gas mixture: (% EO) 12 (%88) Freon

EO Consumption per unit (lb): (month) 20 (year) 240

Total gas consumption (lb): 32,400

EO storage: cylinder Location: behind

EO costs: per load _____ per month _____ per year _____

Sterilizer use per day: 3/5 days Sterilization period: 2 hours

Sterilizer vent: yes Localized area: yes

Always intact: yes Is area enclosed: yes

Drain:

Gas/water separator: yes

Is process equipped with an EO emission control device: yes

Type: Venting system/new Envirogard system

Diameter of stack/vent: _____ (in.) Ht. above roof:

Average flow rate during discharge (acfm):

Aerator used: yes Employee monitoring program: yes, film badge, quarterly
area monitor

Aeration period: 8 to 24 hours

CONTACT REPORT--MRI Project No. 7712-K

A-88-03
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From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 12/13/85

Contacted by: Telephone

Company/Agency: APEDS
New Jersey Division of Environmental Quality
CN 027
Trenton, New Jersey 08625

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DOCKET CONTROL ROOM

Telephone Number: (609) 292-5450

Person(s) Contacted/Title(s)

Mr. Karl Ochs, Information Officer

CONTACT SUMMARY:

The State of New Jersey, Division of Environmental Quality, was contacted to acquire information relative to ethylene oxide (EO) emission sources. Mr. Ochs indicated that any known EO sources on inventory would have to be retrieved from the data base information system. To acquire information an official letter of request must be sent and a cost would be incurred for the computer search.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Jr., Environmental Engineering Department
Date of Contact: 12/13/85
Contacted by: Telephone
Company/Agency: Texas Air Control Board
6330 Highway 290 East
Austin, Texas 78723
Telephone Number: (512) 451-5711

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OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Mr. Paul Henry, Director of Technician Services

CONTACT SUMMARY:

The State of Texas, Texas Air Control Board, was contacted to acquire information relative to ethylene oxide (EO) emissions in the State. Mr. Henry indicated that an official letter of request for information must be submitted.

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 1/10/86

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: School of Veterinary Medicine
Tuskegee Institute
Tuskegee Institute, Alabama 36088

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (205) 727-8174

Person(s) Contacted/Title(s)

Dr. Howard King, Doctor Veterinary Medicine

CONTACT SUMMARY:

Dr. King was contacted to provide information pertaining to ethylene oxide (EO) sterilization practices at the Tuskegee Institute School of Veterinary Medicine. The veterinary school has in operation one AMSCO EO sterilizer used to sterilize delicate instrumentation and some disposable items. This unit meets all present OSHA health, safety and ventilation requirements. A small portable EO sterilizer, Andersen Product, is used in one of the outlying clinics. This unit can be easily transported and uses 100 percent pure EO ampules. Sterilization using the Andersen Portable Unit is conducted over night in a rear area of the clinic. After the sterilization process is complete, the sterilizer gas is vented from the room to a rear access area.

Dr. King was not aware of EO sterilization practices in the surrounding vicinity. However, there may be EO sterilizer applications in area veterinary clinics.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 1/13/86

Contacted by: Telephone

Company/Agency: University of Georgia
College of Veterinary Medicine
Athens, Georgia 30602

Telephone Number: (404) 542-3221

Person(s) Contacted/Title(s)

Amanda Strupp, Central Services

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CONTACT SUMMARY:

Ms. Strupp was contacted to provide information in regards to ethylene oxide (EO) sterilization practices at the University of Georgia. The veterinary school has recently updated it's EO sterilization process. The facility has one Castle EO sterilizer. The present system was modified to update and incorporate techniques, procedures, and ventilation and exhaust requirements to meet OSHA standards.

Ms. Strupp indicated that she knows of no veterinary clinics in the surrounding area that utilizes EO sterilization. Most clinics that require gas sterilization seek use of the facilities at the university or surrounding medical facilities.

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 1/13/86

Contacted by: Telephone

Company/Agency: USAMEDDAC
Preventive Medicine
Ft. Benning, Georgia 31903

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DOCKET CONTROL ROOM

Telephone Number: (404) 545-1144

Person(s) Contacted/Title(s)

Major Anthony Aiken, Environmental Science Officer

CONTACT SUMMARY:

Major Aiken was contacted to provide information regarding ethylene oxide (EO) usage in military hospitals, dental clinics, and veterinary clinics. EO sterilizers are used at the hospital at Ft. Benning. The facility has two AMSCO cart roll in EO sterilizers. The sterilizer process meets all present OSHA requirements. Occupational exposure (8 hour TWA) is measured by environmental technicians at the hospital. Primary EO leakage areas of concern occur at the gas cylinders when they are being changed.

No EO sterilization is used in dental clinics nor veterinary clinics at Ft. Benning. Major Aiken does not know of an EO sterilizer application presently being used in U.S. Army Dental or Veterinary facilities.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 1/14/86

Contacted by: Telephone

Company/Agency: Iowa State University
College of Veterinary Medicine
Ames, Iowa 50011

Telephone Number: (515) 294-7644

Person(s) Contacted/Title(s)

Ms. Gail Anders, Surgery Technician

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CONTACT SUMMARY:

Ms. Anders indicated that the veterinary clinic did not own an ethylene oxide (EO) sterilizer. All items requiring gas sterilizer are done at another hospital facility. She has no idea whether EO is used in surrounding Iowa veterinary clinics.

CONTACT REPORT--MRI Project No. 7712-K

88-03
II E 221
FILE COPY

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 1/14/86

Contacted by: Telephone

Company/Agency: Michigan State University
Veterinary Clinic Center
East Lansing, Michigan 48824

Telephone Number: (517) 353-5420

Person(s) Contacted/Title(s)

Ms. Naomi Green, Supervisor, Central Services

CONTACT SUMMARY:

Ms. Green was contacted to provide information pertaining to ethylene oxide (EO) sterilization practices at the Michigan State University. The veterinary school has in operation one 3M 400C EO sterilizer. The sterilant used in the sterilizer is packaged in 100 gram cartridges containing 100 percent EO. The sterilizer is operated four times per day.

Ms. Green had no knowledge of EO sterilization use in any of the veterinary clinics in the local vicinity. She did indicate that some veterinary clinics may use Andersen Portable sterilizers.

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From: Bruce Boomer, Environmental Systems Department
Date of Contact: 1/23/86
Contacted by: Telephone
Company/Agency: Colorado APCD
Telephone Number: (303) 331-8500
Person(s) Contacted/Title(s)

Various

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OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Colorado has not conducted an emissions inventory yet. The toxic air contaminant list is being revised. EO is on the current list. Various staff members are unaware of any special interest or cases of EO emissions.

From: Bruce Boomer, Environmental Systems Department

Date of Contact: 1/23/86

Contacted by: Telephone

Company/Agency: Indiana State Board of Health

Telephone Number: (317) 633-0600

Person(s) Contacted/Title(s)

Robert Beerman

RECEIVED

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Indiana does not have a toxics program but one is under development. EO would be handled as a VOC under the standard permitting programs. Local Agency inspectors at the variuos locations handle the details. The only known EO sources are the sterilizers at Mead-Johnson and the pharmaceutical facilities. No special problems with EO emissions reported.

From: Bruce Boomer, Environmental Systems Department
Date of Contact: 1/23/86
Contacted by: Telephone
Company/Agency: Louisiana DEQ
Telephone Number: (504) 342-8940
Person(s) Contacted/Title(s)

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DOCKET CONTROL ROOM

Mr. Contractor

CONTACT SUMMARY:

Louisiana is in the process of collecting information on noncriteria pollutants including EO. Recently, inventory requests went out to major industrial facilities. Phase II will include smaller industries.

Louisiana has had regulations in effect for VOC's for the whole State (not just nonattainment areas) since 1981. Regulations cover general organic gas disposal, tanks, loading and unloading, and fugitives from seals, flanges, etc. Mr. Contractor feels they have a handle on typical emissions but accidental releases (and start-up, close-down, etc.) are still a problem. EO emissions do not appear to be a problem. Louisiana is attacking the major problems first--large industry, urban locations, etc., with large exposure opportunities. They will gradually go down the list to smaller sources and compounds that pose smaller problems.

From: Bruce Boomer, Environmental Systems Department

Date of Contact: 1/23/86

Contacted by: Telephone

Company/Agency: Minnesota Pollution Control Agency

Telephone Number: (612) 296-7625

Person(s) Contacted/Title(s)

Lou Chamberlain

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OAQPS AIR
DOCKET CONTROL ROOM

AUG 26 1997

CONTACT SUMMARY:

Minnesota is just getting its toxics program together. They are unaware of any major EO sources or special problems. One pacemaker manufacturer called recently asking about the EO notice in the Federal Register. Minnesota is using a risk model for its toxics program.

From: Bruce Boomer, Environmental Systems Department

Date of Contact: 1/23/86

Contacted by: Telephone

Company/Agency: Oregon DEQ

Telephone Number: (503) 229-5696

Person(s) Contacted/Title(s)

Ed Wood

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QAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Oregon is conducting an emissions inventory at present. EO is on the current list of compounds for inventory. They are not aware of any major sources of EO emissions or past activities with EO. However, hospitals have not been surveyed.

A-88-03

CONTACT REPORT--MRI Project No. 7712-K

II E 227

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 1/23/86

Contacted by: Telephone

Company/Agency: Alabama Veterinary Medical Association
Post Office Box 2370
Auburn, Alabama 36831

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Telephone Number: (205) 826-4530

Person(s) Contacted/Title(s)

Dr. A. H. Groth, Jr., Executive Vice President

CONTACT SUMMARY:

Dr. Groth was contacted to provide information relative to ethylene oxide (EO) sterilization in veterinary clinics. Dr. Groth indicated that he was not aware of EO sterilization practices in veterinary clinics. He suggested that we contact a veterinary surgeon.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 1/23/86

Contacted by: Telephone

Company/Agency: Village Veterinary Clinic
Auburn, Alabama

Telephone Number: (205) 821-7730

Person(s) Contacted/Title(s)

Dr. Womer, Doctor Veterinary Medicine

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DOCKET CONTROL ROOM

CONTACT SUMMARY:

Dr. Womer, a board certified surgeon in veterinary medicine was contacted to acquire information relative to ethylene oxide (EO) sterilization in veterinary clinics. Dr. Womer indicated that he did not use EO sterilization in his veterinary clinic. His reason for not using was that he just never started using it.

From: Calvin L. Green, Jr., Environmental Engineering Department ^{II} F. 229

Date of Contact: 1/24/86

Contacted by: Telephone

Company/Agency: Boulevard Animal Hospital
3900 Western Boulevard
Raleigh, North Carolina 27606

Telephone Number: (919) 828-7468

Person(s) Contacted/Title(s)

Dr. Danny T. Allen, Doctor Veterinary Medicine, President Elect,
North Carolina State Veterinary Medicine Association

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CONTACT SUMMARY:

Dr. Allen was contacted and visited in regards to ethylene oxide (EO) sterilization usage in veterinary clinics. The Boulevard Animal Hospital and Clinic own and utilize a portable EO sterilizer to sterilize apparatus that cannot be sterilized by heat. The Unit is an Andersen AN-72 Anaprolene Sterilizer Tray Module Kit. The sterilizer kit includes a 11" x 16" x 3" nine liter capacity linear bag container, sterilizer liner bags, twist seal closures, and 2.8 g EO (100 percent) ampules.

The EO sterilizer is used once or twice per month to sterilize rubber hose and a saw used for surgery. The sterilization process is conducted outside in a storage building. After the sterilization process is complete (12 hours contact time) the sterilized apparatus are removed from the AN-72 Anaprolene Sterilizer outside of the building and hospital.

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 1/24/86

Contacted by: Telephone

Company/Agency: Material Management
Post Office Box 3901
Duke University Medical Center
Durham, North Carolina -27710

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Telephone Number: (919) 681-4283

Person(s) Contacted/Title(s)

Mr. Bill Dennis, Director, Material Management

CONTACT SUMMARY:

Mr. Dennis called in reference to the Environmental Protection Agency's (EPA) letter of request for a visit to the Duke University Hospital. The purpose of the request for visit was to survey the hospital's ethylene oxide (EO) sterilization facilities. Mr. Dennis indicated that he had not expected an official letter of such magnitude. The visit request must be routed through appropriate administrative and legal channels. He will try to accomplish this by Monday afternoon (January 27, 1986), however, it is very doubtful the survey could be conducted as scheduled on January 28, 1986. He was not sure whether senior management would approve the visit. Indicated he would call January 27, 1986, if the request had gone through channels.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Jr. Environmental Engineering Department

Date of Contact: 1/14/86, 1/29/86

Contacted by: Telephone

Company/Agency: Ohio State University
College of Veterinary Medicine
1900 Coffey Road
Columbus, Ohio 43210

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Telephone Number: (614) 422-3551

Person(s) Contacted/Title(s)

Dr. Craig Miller, Doctor Veterinary Medicine

CONTACT SUMMARY:

Dr. Miller was contacted to provide information relative to ethylene oxide (EO) sterilization practices and usage at the Ohio State University. The veterinary school has two EO sterilizers, a Sybron Castle model No. 7760 and a portable 3M ,pde; 400C. The Castle EO sterilizer is no longer in service because it no longer meets current OSHA health and safety requirements. The 3M 400C does meet current OSHA requirements and is used five times per day. EO sterilizer gas consumption is approximately 10,000 g of 100 percent EO per year (100 cartridges).

Dr. Miller feels there is considerable EO sterilization use by private veterinarians using Andersen products applications. However, he feels that although these sterilizers are OSHA approved they still may be unsafe.

From: Calvin L. Green, Jr., Environmental Engineering Department
Date of Contact: 1/29/86
Contacted by: Telephone
Company/Agency: Washington State University
Veterinary Hospital
McCoy Hall 134
Pullman, Washington 99164
Telephone Number: (509) 335-0711, (509) 335-6052

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Person(s) Contacted/Title(s)

Ms. Doris White, Supervisor, Central Services
Mr. William Packard, Scientific Technician

CONTACT SUMMARY:

The Washington State University Veterinary Hospital was contacted to ascertain the use of ethylene oxide (EO) sterilization at the facility. Ms. White indicated that the veterinary hospital formerly owned and utilized a gas sterilizer however it was taken out of service a few years ago due to changes in OSHA regulations. All items that require gas sterilization are done in another department of the University.

Mr. Packard of the university's Department of Microbiology and Pathology was contacted also in reference to EO sterilization. The department sterilizes equipment and apparatus from the veterinary hospital that requires gas sterilization. An AMSCO sterilizer is in operation that runs approximately four loads per week. He estimates sterilizer gas consumption at approximately 140 lb per month.

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Jr., Environmental Engineering Department
Date of Contact: 1/30/86
Contacted by: Telephone
Company/Agency: Oklahoma State University
College of Veterinary Medicine
Stillwater, Oklahoma 74078
Telephone Number: (405) 624-6648

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DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Ms. Glorinda Carpenter, Animal Technician
Dr. Kenneth Bartels, Doctor Veterinary Medicine

CONTACT SUMMARY:

Ms. Carpenter was contacted to provide information pertaining to ethylene oxide (EO) sterilization practices at Oklahoma State University. The veterinary school own a Castle EO sterilizer, however as of this date it has been taken out of operation. It does not mean the current OSHA safety and health requirements. Equipment that requires gas sterilization is sent to the Stillwater General Hospital.

Dr. Bartels indicated that EO is used by veterinary practioners. Portable applications such as the Anderson Cannisters and ampules are marketed to small veterinary clinics and practioners. These units are reasonably priced therefore they have become available for use.

CONTACT REPORT--MRI Project No. 7712-K

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II E 234

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 1/30/86

Contacted by: Telephone

Company/Agency: University of Illinois
College of Veterinary Medicine
Urbana, Illinois 61801

Telephone Number: (217) 294-7644

Person(s) Contacted/Title(s)

Ms. Becky Strater, Veterinary Technician

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Ms. Strater was contacted to provide informatin relative to ethylene oxide (EO) sterilization practices at the University of Illinois. The university operates one AMSCO sterilizer in the veterinary clinic. No portable units are used. The sterilizer is used approximately once per day. Monthly sterilizer gas consumption is approximately 280 lb per month.

EO sterilization usage by private veterinarians in the surrounding area is not extension but does exists. Those that she is aware of use the Andersen Products cannister.

CONTACT REPORT--MRI Project No. 7712-K

II E 235

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 2/25/86

Contacted by: Telephone

Company/Agency: Frederick Cancer Research
Post Office Box B
Frederick, Maryland 21701

Telephone Number: (301) 695-1451

Person(s) Contacted/Title(s)

Everett Hanel, Director, Environmental Control Section

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DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Hanel said that the facility does use ethylene oxide (EO) to perform in-house sterilization. Two 24" x 36" x 60" chambers are run on a daily basis in the animal production lab and there are two or three other chambers that use EO intermittantly.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth Friedman, Environmental Engineering Department

Date of Contact: 2/25/86

Contacted by: Telephone

Company/Agency: Gambro, Inc.
5000 Chestnut Avenue
Newport News, Virginia 23605

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Telephone Number: (804) 247-0105

Person(s) Contacted/Title(s)

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Frieda Ellis, Personnel Secretary

CONTACT SUMMARY:

Ms. Ellis said that the company is a medical equipment manufacturer and that they operate an ethylene oxide sterilizer. She said the sterilizer runs "all the time." Mr. Henry Sinsabaugh, the Quality Assurance Manager would be the receipt of any questionnaire.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth Friedman, Environmental Engineering Department

Date of Contact: 2/25/86

Contacted by: Telephone

Company/Agency: Glyco, Inc.
Williamsport, Pennsylvania

Telephone Number: (717) 322-4681

Person(s) Contacted/Title(s)

Howard Witt, Safety Manager

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DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Witt said that the Pennsylvania facility uses ethylene oxide (EO) to perform ethoxylation. He said that no other facilities use EO in any capacity.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 2/26/86

Contacted by: Telephone

Company/Agency: Paso Pak Chile Company
Post Office Box 969
Fabens, Texas 79838

Telephone Number: (915) 764-3716

Person(s) Contacted/Title(s)

Danny Gonzales, Plant Manager

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DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company uses EO to fumigate chiles. They fumigate only at the request of the customer. The chamber has not been used in about 2 months. There is no atmospheric EO emission control. This is their only location.

Any questionnaire should be sent to Mr. Tom Peterson, the General Manager, at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 2/27/86

Contacted by: Telephone

Company/Agency: Midwest Sterilization Corp.
Post Office Box 509
Cape Girardeau, Missouri 63701

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Telephone Number: (314) 334-9820

Person(s) Contacted/Title(s)

OAQPS AIR
DOCKET CONTROL ROOM

Audry Eldridge, President

CONTACT SUMMARY:

Mr. Eldridge said that the company operates two sterilizing chambers that use ethylene oxide (12/88 mixture). The chambers are operated on a single shift per day.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 2/28/86

Contacted by: Telephone

Company/Agency: Pacon Manufacturing Corp.
Post Office Box 384
Metuchen, New Jersey 08840

Telephone Number: (201) 754-4500

Person(s) Contacted/Title(s)

Vernon Shannon, President

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company manufactures medical equipment and uses E0 (12/88 gas) for sterilization. Atmospheric E0 emissions are controlled by a scrubber and are near zero.

Mr. Shannon is not aware that the company received a HIMA questionnaire. Any future questionnaires should be sent to Mr. Michael Shannon at the above address.

CONTACT REPORT--MRI Project No. 7712-K

II E 241

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 2/28/86

Contacted by: Telephone

Company/Agency: Plant Disease Research Lab
U.S. Department of Agriculture
Frederick, Maryland

Telephone Number: (301) 663-2333

Person(s) Contacted/Title(s)

Dennis Johnson

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AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The cylindrical EO chamber at this lab is about 30 inches long and 12 inches in diameter. A very small amount of EO is used about three times per week. There is no atmospheric EO emission control.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 2/28/86

Contacted by: Telephone

Company/Agency: SCM Corp.
New York, New York

Telephone Number: (212) 752-2700

Person(s) Contacted/Title(s)

Carl Zipfel, Manager, Department of Environmental Affairs

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AUG 26 1997
OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

SCM Corp. was recently bought by another corporation and this office is being disbanded. EO is used by two subsidiary companies to fumigate spices. Durkee Spices operates a plant in Bethlehem, Pennsylvania, that uses EO; they also operate a plant in Sharonville, Ohio, that discontinued EO use. Baltimore Spice Company operates the following three plants that use EO: (1) El Paso, Texas; (2) Baltimore, Maryland; and (3) Sparks, Nevada. Baltimore Spice has a plant in North Dakota that does not use EO. None of the plants have atmospheric EO emission controls. The plants operate the EO chambers about one cycle per shift. Questionnaires should be sent to Durkee's Bethlehem plant and to Baltimore Spice's Baltimore plant. Mr. Zipfel did not have phone numbers or contacts for those plants readily available.

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 2/28/86

Contacted by: Telephone

Company/Agency: Old Dartmouth Historical Society
Whaling Museum
18 Johnny Cake Hill
New Bedford, Massachusetts 02740

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Telephone Number: (617) 997-0046

Person(s) Contacted/Title(s)

Robert Hauser, Conservator

CONTACT SUMMARY:

The museum has a 18 cubic foot (48" x 36" x 36") Vacudyne chamber that is used approximately once a month. There are no emission controls. The museum is working with a group of 11 other institutions in New England to meet the OSHA standards. Mr. Hauser said that the Boston Public Library has a chamber and that the Smithsonian is researching use of carbon dioxide.

Mr. Hauser requested that his name be placed on our mailing list.

From: David Newton, Environmental Engineering Department

Date of Contact: 2/28/86

Contacted by: Telephone

Company/Agency: Boston Public Library
Post Office Box 286
Copley Station
Boston, Massachusetts 02117

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (617) 536-5400

Person(s) Contacted/Title(s)

Mr. Stuart Walker

CONTACT SUMMARY:

I called Mr. Walker to ask about the use of EO for document fumigation at the Boston Public Library.

Mr. Walker informed me that the library has a new chamber in which documents will be fumigated with EO. However, the chamber is still being set up. The Boston Public Library has not used EO in the past. The chamber is not equipped with an EO emission control device.

Mr. Walker said that an 88/12 Freon/EO mixture will be used to fumigate documents. On the permit application that has been approved by the State Department of Environmental Planning, estimated EO usage was based on the maximum chamber usage that was physically possible, which was one cycle per day. However, Mr. Walker feels that document fumigation is unlikely to occur more frequently than twice per month.

In the near future, OSHA will test the chamber to make certain that employee exposures to EO are at safe levels.

Mr. Walker suggested that any mailings should be directed to:

Mr. B. Joseph O'Neill
Head of Research

or

Mr. Joseph Sarro
Head of Buildings Department
Post Office Box 286
Copley Station
Boston, Massachusetts 02117

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Richards Medical
Memphis, Tennessee

Telephone Number: (901) 396-2121

Person(s) Contacted/Title(s)

Bob Ames

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AUG 26 1997

QAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company currently uses small amounts of 12/88 gas to sterilize medical devices. They are phasing out the use of E0 and by the end of March should be relying solely on a contract sterilizer (Sterilization Services of Tennessee).

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Seamless Hospital Products, Inc.
9660-C Plaza Circle
El Paso, Texas 79927

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DOCKET CONTROL ROOM

Telephone Number: (915) 858-2937

Person(s) Contacted/Title(s)

Ricky Cambron

CONTACT SUMMARY:

There are four sterilization chambers at this facility using a total of about 800 lb/d of gas. It was unclear if this value is for EO or for the 12/88 gas. There is a Chemrox scrubber controlling EO emissions.

As far as Mr. Cambron is aware, they have received no HIMA survey. A Section 114 information request should be sent to Mr. Bill Edwards, the plant manager, at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Seamless Latex
931 Second Avenue, S.E.
Fayette, Alabama 35555

Telephone Number: (205) 932-3202

Person(s) Contacted/Title(s)

Joe Taylor

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QA/QPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company manufactures surgical gloves. The use of EO for sterilization will end in about 2 months. That process is being relocated to the following two sites:

1. Seamless Hospital Products in Ocala, Florida (Bob Moody)
2. Seamless Latex in El Paso, Texas (Bill Edwards)

Mr. Taylor is unaware of receiving a HIMA questionnaire. Any questionnaires should be sent to Mr. Eddy Roberts, the Plant Manager, at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Sherwood Medical
St. Louis, Missouri

Telephone Number: (314) 567-1500

Person(s) Contacted/Title(s)

Valerie, Secretary

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AUG 23 1997

OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company uses E0. For further information we need to talk to
Mr. Donald Price.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Snyder Laboratories
Dover, Ohio

Telephone Number: (216) 343-8801

Person(s) Contacted/Title(s)

Ken Hofacker

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OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company produces medical devices and uses E0. They completed and returned the HIMA survey. This company is a division of Zimmer, which is part of Bristol Meyers.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Spicecraft, Inc.
St. Louis, Missouri

Telephone Number: (314) 231-5400

Person(s) Contacted/Title(s)

Fred Edwards

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AUG 25 1997
OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company uses EO in the production of spices. They completed and returned the ASTA survey.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/4/86

Contacted by: Telephone

Company/Agency: Sterilization Technical Services
7500 W. Henrietta Road
Rush, New York 14543

Telephone Number: (716) 533-1672

Person(s) Contacted/Title(s)

James Whitbourne, President

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DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company is a contract sterilizer using E0. There is no atmospheric emission control at this time. However, because of New York State requirements, a scrubber will be installed in about 3 months. The facility uses 70,000 to 80,000 lb per year of 12/88 gas.

They have not received a HIMA survey. A Section 114 information request should be sent to Mr. Whitbourne at the above address.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/5/86

Contacted by: Telephone

Company/Agency: Sterling Drug, Inc.
Race and Stoeper Streets
Myerstown, Pennsylvania 17067

RECEIVED

AUG 26 1997

Telephone Number: (717) 866-2141

Person(s) Contacted/Title(s)

OAQPS AIR
DOCKET CONTROL ROOM

Harry Jones, Plant Manager

CONTACT SUMMARY:

This company uses EO to sterilize containers. They are considering switching to a contract sterilizer. There is no atmospheric EO emission control device. Mr. Jones did not have an estimate of annual EO use but said that it was a small amount.

A Section 114 information request should be sent to Mr. Jones at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/7/86

Contacted by: Telephone

Company/Agency: Jackson Laboratory
Lower Main Street
Bar Harbour, Maine 04609

Telephone Number: (207) 288-3371

Person(s) Contacted/Title(s)

Arden Peach, Safety Officer

RECEIVED

AUG 26 1987

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The lab has two sterilizers, one of which is run frequently. The chambers use a 12/88 mixture of E0/freon. The exhaust is vented to the atmosphere. Mr. Peach said that he would be the recipient of any questionnaire.

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/7/86

Contacted by: Telephone

Company/Agency: National Animal Disease Center
Post Office Box 70
Ames, Iowa 50010

Telephone Number: (515) 239-8200

RECEIVED

AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Joseph R. Songer, Environmental Health and Safety

CONTACT SUMMARY:

Mr. Songer said that the facility has three chambers that use ethylene oxide. The largest chamber is 3' x 4' x 5'. A second round chamber has a 24" diameter and 3' length and the third chamber has a 6" diameter and 4' length. The ventilation system is a single-pass air system that exhausts 100,000 cubic feet per pass.

Mr. Songer said that the center handles the sterilization for other regional U.S.D.A. facilities that were not able to meet the OSHA standards. He said that the Animal Exotic Diseases Research Laboratory in Plum Island (Greenport) New York performs sterilization as do USDA facilities in East Lansing, Michigan, and Athens; Georgia.

From: David L. Newton, Environmental Engineering Department
Date of Contact: 3/12/86
Contacted by: Telephone
Company/Agency: Araclean Services, Inc.
1 North Beacon
La Grange, Illinois 60525
Telephone Number: (312) 352-3200

RECEIVEDAUG 2 1997
OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Safety Officer and Charles W. Berndt, Divisional Vice-President

CONTACT SUMMARY:

I initially spoke to the safety officer, who was able to provide the basic information. She indicated, however, that future inquiries should be directed either to Ms. Colleen Dahoff or to Mr. Charles W. Berndt.

Araclean Services, Inc., does perform contract E0 sterilization of packaged medical devices. The quantity of E0 used and information on control devices were not available.

Mr. Charles W. Berndt called me back later in the afternoon. He informed me that Araclean Services performs sterilization of clean room garments (surgical gowns, etc.). Employee exposures are well below the OSHA action level of 0.5 ppm averaged over 8 hours. At the present time there is no control device to remove emissions going to the atmosphere. Mr. Berndt was not sure how much sterilizing gas is used at Araclean Services.

Mr. Berndt added that he is the appropriate contact for any further communications such as a written questionnaire.

Mr. Berndt requested that I send him a letter for his files confirming what MRI is doing and the purpose of the study.

A-88-03
88-03

CONTACT REPORT--MRI Project No. 7712-K

II E 256

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/13/86

Contacted by: Telephone

Company/Agency: Heard Museum
22 E. Monte Vista
Phoenix, Arizona 85004

Telephone Number: (602) 252-8840

Person(s) Contacted/Title(s)

Ms. Ann Marshall, Curator

RECEIVED
AUG 26 1997
OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Ms. Marshall said that the museum has a single 8' x 6' x 4' chamber that is used approximately 10 times/year. The chamber is located outside and emissions are vented to the atmosphere. Any further questions should be directed to Mr. Warren Ruder, the building superintendent.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/13/86

Contacted by: Telephone

RECEIVED

Company/Agency: Hollister, Inc.
2000 Hollister Drive
Libertyville, Illinois 60048

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (312) 680-1000

Person(s) Contacted/Title(s)

Ken Riddell, Research and Development

CONTACT SUMMARY:

Mr. Riddell confirmed that the company does use ethylene oxide. The company manufactures medical equipment. Mr. Riddell said that he thought that the company had completed and returned a HIMA survey. Any further questions should be directed to Jerome Saxon, director of legal affairs.

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 3/13/86

Contacted by: Telephone

RECEIVED

Company/Agency: C. F. Sauer Company
Post Office Box 2346
Greenville, South Carolina 29602

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (803) 288-3211

Person(s) Contacted/Title(s)

Mr. Cleve Noell, Vice President of Products

CONTACT SUMMARY:

Mr. Noell provided the following information in regards to ethylene oxide (EO) usage at the above listed facility:

1. EO sterilization usage: Yes, but not at this facility
2. Purpose: Sterilization of spices
3. EO consumption: did not know

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/19/86

Contacted by: Telephone

RECEIVED

Company/Agency: Lederle Laboratory Division
American Cynamid
Middletown Road
Pearl River, New York 10965

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (914) 735-5000

Person(s) Contacted/Title(s)

Sue Johnson, Industrial Hygienist

CONTACT SUMMARY:

Ms. Johnson said that the facility frequently operates an EO sterilization chamber. They are in the process of adding a scrubber to comply with State regulations. She said that the company completed and returned a HIMA questionnaire.

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/19/86

Contacted by: Telephone

Company/Agency: Lowie Museum of Anthropology
University of California
Berkeley, California 94720

Telephone Number: (415) 642-3681

Person(s) Contacted/Title(s)

Jeffrey Brown, Senior Museum Scientist

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The museum operates a 500-ft³ Vacudyne chamber that is run every 6 weeks to 2½ months. The EO emissions pass through a water sealed vacuum pump. Mr. Brown would be the person to receive any questionnaire.

From: David L. Newton, Environmental Engineering Department

Date of Contact: 3/19/86

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: American Pharmseal Laboratories
Irwindale, CaliforniaOAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (818) 962-3531

Person(s) Contacted/Title(s)

Mr. John Feeney

CONTACT SUMMARY:

Mr. Feeney informed me that American Pharmseal Laboratories does sterilize medical equipment that they manufacture with EO. The company is a member of the Health Industry Manufacturers Association (HIMA). They probably responded to the HIMA survey. Their response would be among those for Baxter-Travenol Laboratories, their parent company.

FILE COPY
1-88-03

From: David L. Newton, Environmental Engineering Department

Date of Contact: 3/19/86

Contacted by: Telephone

RECEIVEDCompany/Agency: Findley Research, Inc.
420 Airport Road
Fall River, Massachusetts 02720AUG 26 1997
OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (617) 679-8800

Person(s) Contacted/Title(s)

Ms. Sarah Degan, Microbiologist

CONTACT SUMMARY:

I originally called Mr. Harold Schaefer, but he is no longer with the company.

Ms. Degan informed me that Findley Research, Inc., does use EO to perform contract sterilization. The second Findley Research plant in Berkley, Massachusetts is no longer operational. Ms. Degan thought that the company had very recently joined the Health Industry Manufacturers Association.

Ms. Degan was not sure of the quantity of EO used at Findley Research. The person who would know information of that type and to whom future questions should be addressed is:

Ms. Lisa Curran
Manager of Quality Assurance
Findley Research, Inc.
420 Airport Road
Fall River, Massachusetts 02720

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/20/86

Contacted by: Telephone

Company/Agency: Lukens International
Post Office Box 1040
Lynchburg, Virginia 24505

Telephone Number: (804) 528-0066

Person(s) Contacted/Title(s)

Dr. Donald Boyd, Executive Vice President

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Boyd said that the company has two sterilization chambers for use with 12/88 gas mixtures. One chamber is 9' x 9' x 5' and the other is 5' x 4' x 3'. The chambers are used less than once per month. Most sterilization is sent to Isomedix, a radiation contract sterilizer.

The chambers vent ethylene oxide through a water jacket before draining to the public treatment system.

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/20/86

Contacted by: Telephone

Company/Agency: Medlon, Inc.
3325 Glen Oaks Boulevard
Burbank, California 91504

Telephone Number: (818) 954-9541

Person(s) Contacted/Title(s)

Don Fouratt, Production Engineer

RECEIVED

AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The company is a medical device manufacturer and does perform ethylene oxide sterilization. They also send out work to contract radiation sterilizers. Any further questions should be addressed in writing to Mr. Paul Pietryka, Production Manager.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/7/86

Contacted by: Telephone

Company/Agency: Jackson Laboratory
Lower Main Street
Bar Harbour, Maine 04609

Telephone Number: (207) 288-3371

Person(s) Contacted/Title(s)

Arden Peach, Safety Officer

RECEIVED

AUG 26 1987

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The lab has two sterilizers, one of which is run frequently. The chambers use a 12/88 mixture of E0/freon. The exhaust is vented to the atmosphere. Mr. Peach said that he would be the recipient of any questionnaire.

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Company/Agency: National Animal Disease Center
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Telephone Number: (515) 239-8200

RECEIVED

AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

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CONTACT SUMMARY:

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Mr. Songer said that the center handles the sterilization for other regional U.S.D.A. facilities that were not able to meet the OSHA standards. He said that the Animal Exotic Diseases Research Laboratory in Plum Island (Greenport) New York performs sterilization as do USDA facilities in East Lansing, Michigan, and Athens; Georgia.

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Contacted by: Telephone
Company/Agency: Araclean Services, Inc.
1 North Beacon
La Grange, Illinois 60525
Telephone Number: (312) 352-3200

RECEIVEDAUG 2 1997
OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Safety Officer and Charles W. Berndt, Divisional Vice-President

CONTACT SUMMARY:

I initially spoke to the safety officer, who was able to provide the basic information. She indicated, however, that future inquiries should be directed either to Ms. Colleen Dahoff or to Mr. Charles W. Berndt.

Araclean Services, Inc., does perform contract E0 sterilization of packaged medical devices. The quantity of E0 used and information on control devices were not available.

Mr. Charles W. Berndt called me back later in the afternoon. He informed me that Araclean Services performs sterilization of clean room garments (surgical gowns, etc.). Employee exposures are well below the OSHA action level of 0.5 ppm averaged over 8 hours. At the present time there is no control device to remove emissions going to the atmosphere. Mr. Berndt was not sure how much sterilizing gas is used at Araclean Services.

Mr. Berndt added that he is the appropriate contact for any further communications such as a written questionnaire.

Mr. Berndt requested that I send him a letter for his files confirming what MRI is doing and the purpose of the study.

A-88-03
88-03

CONTACT REPORT--MRI Project No. 7712-K

II E 256

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/13/86

Contacted by: Telephone

Company/Agency: Heard Museum
22 E. Monte Vista
Phoenix, Arizona 85004

Telephone Number: (602) 252-8840

Person(s) Contacted/Title(s)

Ms. Ann Marshall, Curator

RECEIVED
AUG 26 1997
OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Ms. Marshall said that the museum has a single 8' x 6' x 4' chamber that is used approximately 10 times/year. The chamber is located outside and emissions are vented to the atmosphere. Any further questions should be directed to Mr. Warren Ruder, the building superintendent.

CONTACT REPORT--MRI Project No. 7712-K

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Contacted by: Telephone

RECEIVED

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2000 Hollister Drive
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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

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Ken Riddell, Research and Development

CONTACT SUMMARY:

Mr. Riddell confirmed that the company does use ethylene oxide. The company manufactures medical equipment. Mr. Riddell said that he thought that the company had completed and returned a HIMA survey. Any further questions should be directed to Jerome Saxon, director of legal affairs.

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RECEIVED

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

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Mr. Cleve Noell, Vice President of Products

CONTACT SUMMARY:

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1. EO sterilization usage: Yes, but not at this facility
2. Purpose: Sterilization of spices
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RECEIVED

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American Cynamid
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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

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Person(s) Contacted/Title(s)

Sue Johnson, Industrial Hygienist

CONTACT SUMMARY:

Ms. Johnson said that the facility frequently operates an EO sterilization chamber. They are in the process of adding a scrubber to comply with State regulations. She said that the company completed and returned a HIMA questionnaire.

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Company/Agency: Lowie Museum of Anthropology
University of California
Berkeley, California 94720

Telephone Number: (415) 642-3681

Person(s) Contacted/Title(s)

Jeffrey Brown, Senior Museum Scientist

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The museum operates a 500-ft³ Vacudyne chamber that is run every 6 weeks to 2½ months. The EO emissions pass through a water sealed vacuum pump. Mr. Brown would be the person to receive any questionnaire.

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Date of Contact: 3/19/86

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: American Pharmseal Laboratories
Irwindale, CaliforniaOAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (818) 962-3531

Person(s) Contacted/Title(s)

Mr. John Feeney

CONTACT SUMMARY:

Mr. Feeney informed me that American Pharmseal Laboratories does sterilize medical equipment that they manufacture with EO. The company is a member of the Health Industry Manufacturers Association (HIMA). They probably responded to the HIMA survey. Their response would be among those for Baxter-Travenol Laboratories, their parent company.

FILE COPY
1-88-03

From: David L. Newton, Environmental Engineering Department

Date of Contact: 3/19/86

Contacted by: Telephone

RECEIVEDCompany/Agency: Findley Research, Inc.
420 Airport Road
Fall River, Massachusetts 02720AUG 26 1997
OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (617) 679-8800

Person(s) Contacted/Title(s)

Ms. Sarah Degan, Microbiologist

CONTACT SUMMARY:

I originally called Mr. Harold Schaefer, but he is no longer with the company.

Ms. Degan informed me that Findley Research, Inc., does use EO to perform contract sterilization. The second Findley Research plant in Berkley, Massachusetts is no longer operational. Ms. Degan thought that the company had very recently joined the Health Industry Manufacturers Association.

Ms. Degan was not sure of the quantity of EO used at Findley Research. The person who would know information of that type and to whom future questions should be addressed is:

Ms. Lisa Curran
Manager of Quality Assurance
Findley Research, Inc.
420 Airport Road
Fall River, Massachusetts 02720

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/20/86

Contacted by: Telephone

Company/Agency: Lukens International
Post Office Box 1040
Lynchburg, Virginia 24505

Telephone Number: (804) 528-0066

Person(s) Contacted/Title(s)

Dr. Donald Boyd, Executive Vice President

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Boyd said that the company has two sterilization chambers for use with 12/88 gas mixtures. One chamber is 9' x 9' x 5' and the other is 5' x 4' x 3'. The chambers are used less than once per month. Most sterilization is sent to Isomedix, a radiation contract sterilizer.

The chambers vent ethylene oxide through a water jacket before draining to the public treatment system.

CONTACT REPORT--MRI Project No. 7712-K

II E 264

From: Elizabeth M. Friedman, Environmental Engineering Department
Date of Contact: 3/20/86
Contacted by: Telephone
Company/Agency: Medlon, Inc.
3325 Glen Oaks Boulevard
Burbank, California 91504
Telephone Number: (818) 954-9541

RECEIVED

AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Don Fouratt, Production Engineer

CONTACT SUMMARY:

The company is a medical device manufacturer and does perform ethylene oxide sterilization. They also send out work to contract radiation sterilizers. Any further questions should be addressed in writing to Mr. Paul Pietryka, Production Manager.

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/20/86

Contacted by: Telephone

Company/Agency: Meer Corporation
9500 Railroad Avenue
North Bergen, New Jersey 07047

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (201) 861-9500

Person(s) Contacted/Title(s)

Harold Montory, Purchasing Agent

CONTACT SUMMARY:

The company uses ethylene oxide (EO) as a sterilizing gas for botanical products. The single chamber is operated every 3 days. Approximately one pallet (six cylinders) of 12/88 sterilizing gas are used every month. Monthly EO emissions are approximately 200 pounds. The chamber is a Vacudyne system with water sealed pumps.

Any further questions should be addressed to Dr. William Meer, Owner.

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 3/20/86

Contacted by: Telephone

Company/Agency: Merck Sharp and Dohme
Westpoint, Pennsylvania 19486

Telephone Number: (215) 661-5000

Person(s) Contacted/Title(s)

Barry Starkman, Safety and Industrial Hygiene Engineer

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

The company does use ethylene oxide, any further questions should be addressed in writing to Mr. Starkman. //

From: David L. Newton, Environmental Engineering Department

Date of Contact: 3/20/86

Contacted by: Telephone

Company/Agency: Crescent Food Company
Post Office Box 3026
Seattle, Washington 98114

Telephone Number: (206) 623-7140

Person(s) Contacted/Title(s)

Mr. Terry Cooke, Safety Director

RECEIVED
AUG 26 1997
OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Mr. Cooke informed me that Crescent Food Company does use EO to fumigate spices. He indicated that the appropriate contact for any questions about EO is Faye Mattson-Cotter, their legal counsel. She is out of town this week. Mr. Cooke suggested that I call her back on Monday.

Ms. Mattson-Cotter would be the appropriate recipient of any questionnaire, which should be mailed to the above address.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: Tone Brothers, Inc.
Des Moines, Iowa

Telephone Number: (515) 262-9721

Person(s) Contacted/Title(s)

Morris Binder

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company uses EO in the production of spices. They completed and returned the ASTA survey.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: U.S.C.I.
Billerica, Massachusetts

Telephone Number: (617) 667-2511

Person(s) Contacted/Title(s)

Joe Piantedosi

RECEIVED
AUG 26 1997
OAGPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company is a division of C. R. Bard, uses EO, and completed and returned the HIMA survey.

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: U.S. Clinical Products
Post Office Box 1667
Richardson, Texas 75083

Telephone Number: (214) 690-8570

Person(s) Contacted/Title(s)

Butch Antill

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company, a division of A. H. Robbins, manufactures medical supplies and uses about 1,000 lb per week of 12/88 gas. There is no EO atmospheric emission control device.

A Section 114 information request should be sent to Win Singletary, the general manager, at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department
Date of Contact: 3/24/86
Contacted by: Telephone
Company/Agency: Walpak Company
50 W. Carpenter Road
Wheeling, Illinois 60090
Telephone Number: (312) 541-4790

RECEIVED

AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

John Laemmar, Vice President for Regulatory Affairs and Quality Assurance

CONTACT SUMMARY:

This company is an independent contract sterilizer for medical supplies. Mr. Laemmar could not provide an estimate of EO use. There is no atmospheric EO emission control device.

A Section 114 information request should be sent to Mr. Laemmar at the above address.

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: Ways and Means, Inc.
632 Irwin
San Rafael, California 94901

Telephone Number: (415) 456-2815

Person(s) Contacted/Title(s)

Peter Lind

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

This company produces disposable medical supplies by plastic injection molding. They use about 10 to 20 lb per day of EO. Emissions are controlled by a scrubber.

Mr. Lind is not sure if they received the HIMA survey; he sees so much paperwork he cannot remember it all. A Section 114 information request should be sent to him at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: The West Company
Medical Plastics Division
Cemetary and Oliver Streets
Jersey Shore, Pennsylvania 17740

RECEIVED

AUG 26 1997

Telephone Number: (717) 398-1133

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Roy Billman

CONTACT SUMMARY:

This company manufactures medical supplies and uses EO. There is no atmospheric EO emission control device. Mr. Billman could not estimate EO use. West Company has a plant in Montgomery, Pennsylvania, but no EO is used there.

As far as Mr. Billman is aware, they have not received a HIMA survey. A Section 114 information request should be sent to Mr. John Neely, the operations manager, at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: Wixon Industries
1390 E. Bolivar Avenue
Milwaukee, Wisconsin 53207

Telephone Number: (414) 481-8900

Person(s) Contacted/Title(s)

Ron Hinzpeter, Purchasing Director

CONTACT SUMMARY:

This company produces spices and uses about 6.5 lb of EO per day. There is no atmospheric EO emission control device.

They are a member of ASTA but Mr. Hinzpeter is unaware of receiving an ASTA survey. A Section 114 information request should be sent to Mr. Hinzpeter at the above address.

RECEIVED
AUG 26 1997
OAGPS AIR
DOCKET CONTROL ROOM

From: Cecily Beall, Environmental Engineering Department

Date of Contact: 3/24/86

Contacted by: Telephone

Company/Agency: Wyeth Laboratories, Inc.
611 E. Nield Street
West Chester, Pennsylvania 19382

RECEIVED

AUG 26 1997

Telephone Number: (215) 696-3100

Person(s) Contacted/Title(s)

OAQPS AIR
DOCKET CONTROL ROOM

Thomas Hershey

CONTACT SUMMARY:

This company does use EO. Although this company is a member of HIMA, Mr. Hershey is unaware of receiving the HIMA survey. It is possible that someone else received and answered it. A Section 114 information request should be sent to Mr. T. Frank Gannon, the plant manager, at the above address.

CONTACT REPORT--MRI Project No. 7712-K

From: Elizabeth M. Friedman, Environmental Engineering Department

Date of Contact: 4/1/86

Contacted by: Telephone

Company/Agency: Medline Industries, Inc.
One Medline Place
Northbrook, Illinois 60060

RECEIVED

Telephone Number: (312) 949-5500

AUG 26 1997

Person(s) Contacted/Title(s)

OAQPS AIR
DOCKET CONTROL ROOM

John Stegmeyer, Production Manager

CONTACT SUMMARY:

The company manufactures Class I hospital supplies and operates three ethylene oxide chambers. The chambers are run four to five times/day. There is no emission control/recovery. The company did not receive a HIMA questionnaire.

CONTACT REPORT--MRI Project No. 8692-K

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 4/10/86

Contacted by: Telephone

Company/Agency: Castle: Division of Sybron Corp.
1777 East Henrietta Road
Post Office Box 23077
Rochester, New York 14692

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OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (716) 475-1400

Person(s) Contacted/Title(s)

Mr. T. K. (Chip) Moore, Manager, Product Support

CONTACT SUMMARY:

Mr. Moore provided the following information in regards to EO emission control devices for hospital EO sterilizers. Castle does not market nor sell a device that removes EO emissions from the exhaust gas flow stream. They have not done any research and development in terms of producing such a device. He did recommend two companies that had developed and were marketing such devices:

Mine Safety Appliance Company (MSA)
Heat Systems of Connecticut

CONTACT REPORT--MRI Project No. 8692-K

From: Calvin L. Green, Environmental Engineering Department
Date of Contact: 4/10/86
Contacted by: Telephone
Company/Agency: Duke University Hospital
Duke University
Durham, North Carolina
Telephone Number: (919) 684-6320

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OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Dr. Thoman, Chief, Environmental Services

CONTACT SUMMARY:

Dr. Thoman provided the following information relative to EO sterilization and control technologies. The University Medical Center incorporates eight EO sterilizers in several sections of the medical center. The majority of the units are located in the Central Materials Section. Most of the sterilizers are independently ducted directly to the atmosphere. All areas where EO sterilizers are located are under negative pressure with continuous air exchanges.

Dr. Thoman related that the University reviewed the prospect of installing a control device to reduce EO concentration in EO exhaust emissions. This device, a catalytic converter, was manufactured by Mine Appliances Company. The capital cost of the unit was \$10,000 to \$15,000. Installation costs ranged from \$20,000 to \$30,000 escalating the costs to approximately \$45,000. This unit would have been steam powered from steam lines on site utilizing a heat exchanger. There were also problems with physically installing the unit in that it would necessitate ducting and additional support structure and providing a place to install. The University decided the purchase and installation of the control device was cost prohibitive and did not install.

Dr. Thoman was requested to provide MRI with a copy of the planning and design worksheets that were used for the planning and installation of the proposed control device.

From: Calvin L. Green, Environmental Engineering Department
Date of Contact: 4/11/86
Contacted by: Telephone
Company/Agency: Damas Corp.
8 Romanelli Avenue
South Hackensack, New Jersey 07606
Telephone Number: (201) 489-0525

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OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Mr. Dave Smith, President

CONTACT SUMMARY:

Mr. Smith provided the following information in regards to EO emission control devices. Damas manufactures several EO emission control devices, Tri-Phase EtO Scrubber Systems. The systems are applicable to large industrial EO sterilization processes with gas stream flow rates from 40 to 400 cfm. A smaller unit has been modified that could control EO emissions from large hospital sterilizers. The estimated cost of installing and operating this unit are as follows:

Capital costs: \$10,000

Annualized costs: ≤\$10,000

On site construction charges: ?

Pump: ?

Closed loop water cooling: ?

Energy costs: ?

Explosion prevention additions: 20 percent capital costs

A-88-03

II E 280

CONTACT REPORT--MRI Project No. 8692-K

From: Calvin L. Green, Environmental Engineering Department

Date of Contact: 4/30/86

Contacted by: Telephone

Company/Agency: Seamless Hospital Products
Division of Dart Industries
1909 Northeast 25th Avenue
Ocala, Florida 32670

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DOCKET CONTROL ROOM

Telephone Number: (904) 732-0600

Person(s) Contacted/Title(s)

Mr. Terry Tiazza, Engineering Manager

CONTACT SUMMARY:

Mr. Tiazza was contacted to acquire information relevant to Ethylene Oxide (EO) control devices and technologies. Mine Safety Appliances Company (MSA) of Pittsburgh, Pennsylvania informed MRI that the above company had in operation an EO gas control device manufactured by MSA.

Mr. Tiazza indicated the following:

1. Seamless Hospital Products do have a MSA EtO Abator System installed; however, it is not yet operational.
2. Presently, MSA representatives are on site preparing the device for preliminary tests and to place in operation.
3. Call back in a week or two to discuss operation and the possibility of a discussion and visit.

CONTACT REPORT--MRI Project No. 8692-K

UNCL
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1488-03

From: Al Meiners, Environmental Systems Department

II E 281

Date of Contact: 7/9/86

Contacted by: Telephone

Company/Agency: Chemrox, Inc.
4695 Main Street
Bridgeport, Connecticut

Telephone Number: (203) 372-5455

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Person(s) Contacted/Title(s)

Mr. Pankaj Desai, Vice President of Sales and Marketing

CONTACT SUMMARY:

Mr. Peter Cashman, their CEO, will accompany Pankaj to the meeting at MRI on July 15.

They have a sterilizer (9 cu ft) in their lab and are trying to get one installed in a local hospital.

Pankaj said it "might be difficult" to supply equipment to our lab for testing, but they would consider it. They would rather not leave their equipment where someone could "take it apart and find out what it is all about". I told him that we could have a confidentiality agreement. He said that our own personnel or test crew would be welcome to test their system under various conditions at their lab.

I sent Pankaj a map to MRI.

From: Al Meiners, Environmental Systems Department
Date of Contact: 7/23/86
Contacted by: Telephone
Company/Agency: EPA
Telephone Number:

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OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Chuck Darwin

CONTACT SUMMARY:

I called Chuck to tell him our proposed plans for Phase I and Phase II and our estimate^d budget for Phase II. These items had been discussed previously by Lloyd, Bruce and I.

I told him that our top priority was a test of the MSA system. This is the only system currently installed in hospitals and handles contaminated air from several sources. This system could be a basis for EPA regulation and our tests will give us input on various sources on EO from the aerator, from around the sterilizer door and from the ethylene tank storage. Our second priority are the acid scrubbers which would be significantly cheaper in cost and more efficient in the number of lives saved per dollar. These systems can apparently handle most of the ethylene oxide that is emitted from the sterilizer. The scrubber systems could be especially effective for small hospital who could not afford the expensive MSA system and have fewer or smaller sterilizers. I told Chuck that we were thinking of testing just one scrubber and that would probably be the one which was first demonstrated at a hospital.

The Tigg system would be studied in an experimental laboratory program at MRI Kansas City.

I told him we could submit a general QA/QC plan. This plan could be submitted ^{with} the Phase I report but more specific information would be needed prior to testing the MSA system and the acid scrubber system. We feel that we must visit the sites where these systems are installed before we can write an adequate QA/QC plan.

I gave him our preliminary cost estimates:

MSA	59.7
Acid scrubbers	49.6
Tigg system	<u>44.6</u>
Total	153.9

I told him that we have assumed that we will not need to do any extensive analytical methods development although some methods evaluation will be required. We have also assumed that practically no costs for equipment, sterilizers, control systems, etc. will be incurred. I told him that we felt that Tigg would be very pleased to provide us with the necessary equipment for testing their system. Our analytical methodology will be similar to that used by John Marguson.

I told him we have budgeted for both Chemrox and Damas Corporation but he agreed it would be best to pick just one and test it. He suggested that we go with the one that we think is the best and I said our criteria of selecting the first one to be installed in a hospital is probably a good selection principle.

Chuck and I agree that it is not necessary to prove the acid hydrolysis technology. What is important is to see that the technology is properly applied to hospitals, particularly with regard to the proper sizing and cost of the unit. Chuck does not believe that a laboratory test would satisfy their requirements. He thinks these tests need to be done in a hospital.

✓ Chuck was concerned whether or not we would be able to define all the requirements and methodology and so forth in our test plan with enough precision to allow us to tie down the dollar figures. He does not want us to come back and tell him that we need even \$10,000 additional three months down the road because of something we did not anticipate. He was particularly concerned about our ability to budget Phase II without site visits. I told him that I thought we had budgeted adequately to send senior engineers to the site and then provide adequate time for writing the test plan and the QA/QC plan following the site visit (we are planning site visits to two hospitals, one in which an MSA unit is installed and the second in which the Chemrox or Damas units are installed).

Chuck wanted to talk this approach over with his QA people, he was concerned about the timing problem because he needs 15 to 20 days for them to review the QA plan. He called me back later in the day and said that it would be okay to provide them with a general QA/QC plan followed by more specific QA/QC details following the site visit.

I told him we wanted to stay within the Phase I budget and get started on Phase II. He said this approach sounds good to him.

He has no problem with the costs I quoted and he thinks that EPA can meet these. He also thought that this would give them a well-rounded technology package concerning three different technology concepts (he said to make any testing on "carbon adsorption" last and if course it is our last priority). I have not told Chuck that this technology is actually not carbon because of our confidentiality agreement.

Chuck suggested that we might want to contact Dr. Cooper's laboratory at the University of Central Florida for the Tigg studies. He said we might be able to get it done cheaper than the \$44,000 we quoted. I said we would look in to it. I told him that our problem to date with Dr. Cooper was that we have to guarantee him a certain number of days. Chuck said he did not want us

to incur any costs that we did not get anything for. We talked about the probability that ^{IF} the work was done in Florida, the majority of the work would be done by graduate students and that they may have some difficulty meeting time and cost schedules.

Chuck again said that he did not have a problem with our preliminary cost figures. he said that that is approximately the ballpark that they had hoped for. In fact, they would not be able to go any higher than that.

We talked about testing the MSA system possibly in September or early October. I told him that we had not yet gotten permission to perform these tests. He thought that we would need to go to the hospitals in order to get this permission. I told him that we probably had enough funds available in Phase I for this trip if really necessary.

We discussed MSA's reluctance to talk to us without pay and he suggested that we should probably get rather blunt with them. We both felt that we needed MSA's cooperation in this study and that if we have to pay them we will.

Chuck called back later that day and said that we should proceed as if we had sufficient funds to carry out all three of the proposed tests.

I asked how to transmit this information to him and he said it should be part of the Phase I interim report. The report should describe our plans for Phase II and it should contain a budget.

Chuck said that he will use this report to prepare a scope of work.

CONTACT REPORT--MRI Project No. 8692-K

From: Bruce Nicholson, Environmental Engineering Department
Date of Contact: 7/30/86
Contacted by: Telephone
Company/Agency: Children's Hospital
Philadelphia, Pennsylvania
Telephone Number: (215) 596-9755

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OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Barry Knopf, Director of Safety and Environmental Health

CONTACT SUMMARY:

I spoke with Mr. Knopf to get more information on the MSA unit there. He confirmed they treat sterilizer gas, aerators, and room air with the unit. They have had periodic testing usually via GC that shows the unit is still effective. However, recently they switched to tests using a continuous "electronic" monitor at the inlet and outlet. He was not sure about factoring out the dilution rate. The tests were arranged by the maintenance department in plant operations. They may have more information. The testing contractor is Paul Coward of Coward, Eastment & Company at (215) 567-1401. He should have more information on how the tests were conducted and the test reports. He should also have cost information.

Mr. Knopf thought that a test program there would be no problem. Send him a letter with suggested dates and he'll arrange it.

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CONTACT REPORT--MRI Project No. * OAQPS AIR
DOCKET CONTROL ROOM

From: Mr. Pat Murphy, Environmental Engineering Department

Date of Contact: August 4, 1986

Contacted by: Telephone

Company/Agency: Barnes Hind Pharmaceutical
895 Kifer Road
Sunnyvale, California 94086

Telephone Number: (408) 236-5462

Person(s) Contacted/Title(s)

Ms. Janet Patzman

CONFIRMATION	<input type="checkbox"/> BY MAIL
DATE	
TIME	
RESPONSE	
DATE	
TIME	
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

CONTACT SUMMARY:

Ms. Patzman was contacted to obtain information regarding the Vacudyne Reclamation Unit that Barnes-Hind is using at their ^{Sunnyvale, CA} facility. Ms. Patzman said that they have had a Vacudyne dessicator since 1980 and the reclamation device since 1983. She noted that there have been no significant problems with either the dessicator or reclamation device.

Ms. Patzman said that the reclamation unit is located outside on a concrete pad and that the EO is stored in a Division I Class I area. The reblending area is located outside in a Division I, Class I area.

Ms. Patzman said that the reclamation device is 80 percent efficient for the entire mixture but that she was unsure about the individual efficiencies of each evacuation. She also stated that the reclamation device operates throughout the evacuation of the sterilizer which is approximately 50 minutes long and consists of two evacuations of the sterilizer

CONTACT REPORT--MRI Project No. 7723-K

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 11/24/86

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Contacted by: Telephone

AUG 26 1997

Company/Agency: A.D.T. Lab Industries, Inc.
20600 Kenrick Avenue
Lakeville, Minnesota 55044

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (612) 469-5539

Person(s) Contacted/Title(s)

Donald Clarke, President

CONTACT SUMMARY:

Mr. Clarke was contacted for clarification of information submitted in response to an EPA information request on ethylene oxide.

I asked about the amounts of ethylene oxide reported to be used in A.D.T.'s two chambers (Chamber No. 1: 850 lb/yr; Chamber No. 2: 400 lb/yr). The reported gas mixture was 12/88 with total gas usage rates of 10,000 lb/yr for Chamber No. 1 and 5,000 lb/yr for Chamber No. 2. Since the 12/88 is on a weight basis, the resulting amount of ethylene oxide used would be 1,200 lb/yr for Chamber No. 1 and 600 lb/yr for Chamber No. 2. Mr. Clarke's reply indicated that the net ethylene oxide use was calculated from the total gas mixture using a percentage by volume number.

I also asked Mr. Clarke if the two chambers are manifolded together to a single emission source (reported as not in l.f. of the information request but as combined to one Vacudyne scrubber in Part III.) The following diagram was explained:

1,000 ft ³	PUMP	VACUDYNE SCRUBBER	"BIG SCRUBBER"
RECIRCULATED WATER			

128 ft ³	PUMP
---------------------	------

No efficiency information was known for the "big scrubber." Mr. Clarke said the Vacudyne scrubber takes care of most of the ethylene oxide, and the "big scrubber" does very little. He felt that emissions are low for the 128 ft³ chamber and, therefore, controls are not critical.

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 12/3/86

Contacted by: Telephone

Company/Agency: Overseas Spice Company
528 Ferry Street
Newark, New Jersey 07105

Telephone Number: (201) 465-1551

Person(s) Contacted/Title(s)

Receptionist

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DOCKET CONTROL ROOM

CONTACT SUMMARY:

Contacted to find out if Overseas Spice Company in New York still existed.

The receptionist informed me that the New York plant was closed about 3 years ago; operations were moved to New Jersey.

From: Vicki M. Soltis, Environmental Engineering Department

Date of Contact: 12/17/86

Contacted by: Telephone

Company/Agency: Alcon Laboratories, Inc.
6201 South Freeway
Fort Worth, Texas 76134-2099

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Telephone Number: (817) 551-8475

Person(s) Contacted/Title(s)

Jim Snyder

CONTACT SUMMARY:

Mr. Snyder was contacted to check on the status of work on revising his original Section 114 information request response. Original chamber sizes, ethylene oxide use, and cycle times did not make sense (ethylene oxide use was very low compared to size of chambers and number of cycles per year.) Mr. Snyder expects a new and accurate response to be ready by next week, will send.

A-88-03

II E 288

CONTACT REPORT--MRI Project No. 7712-K

From: Calvin L. Green, Jr., Environmental Engineering Department

Date of Contact: 12/18/86

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Contacted by: Telephone

AUG 26 1997

Company/Agency: Michigan Air Quality Division
Michigan Department of Natural Resources
Post Office Box 30028
Lansing, Michigan 48909

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (517) 373-7023

Person(s) Contacted/Title(s)

Ms. Danita Brandt

CONTACT SUMMARY:

Ms. Brandt was contacted to acquire information relative to ethylene oxide (EO) emission sources. Ms. Brandt indicated that the State has no inventory of specific air emission sources. However, the State has worked with emission sources found at facilities such as sterilizers at hospitals, museums, and medical equipment and supply companies.

From: Vicki Soltis, Environmental Engineering Department

Date of Contact: 1/13/87 and 2/4/87

Contacted by: Telephone

Company/Agency: Barnes Hind, Inc.
895 Kifer Road
Sunnyvale, California 94086

Telephone Number: (408) 736-5462

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DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Janet Patzman

CONTACT SUMMARY:

Ms. Patzman was initially contacted to check on the status of the response to the Section 114 information request on ethylene oxide. Ms. Patzman was going to talk to her manager (the engineer in charge of installing the reclamation unit) who is completing the response.

Ms. Patzman was recontacted to again check on the status of the response to the information request. She stated that the response was completed that morning and after she reviewed it, she would send it out.

*Have copy
in book*

FILE COPY

A-88-03

II E 290

CONTACT REPORT--MRI Project No. 7712-K

From: David Newton, Environmental Engineering Department

Date of Contact: 2/27/87 ³² 87

Contacted By: Telephone

Company/Agency Specialty Gas, Inc.
20600 Kenrick Avenue
Lakeville, MN 55044

Telephone Number: (612) 469-5539

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Person(s) Contacted/Title(s)

Mr. Don Clarke

CONTACT SUMMARY:

I called Specialty Gas to confirm whether EO sterilization is performed at the company and to obtain the name and address of a contact.

Mr. Clarke confirmed that Specialty Gas performs contract sterilization of medical equipment. He said that Specialty Gas is regulated by the FDA and that someone from Washington, D.C., comes to inspect the company every year. Specialty Gas is not a member of the Health Industry Manufacturers Association (HIMA).

Mr. Clarke said that the sterilization chamber used at Specialty Gas was manufactured by Vacu-dyne and uses a water-sealed pump and a baffle tank containing water to remove EO from the sterilizer exhaust. He said that the water "neutralizes" the EO. He was not sure of the pH of the water, but he said that the control system came with the sterilization chamber. Mr. Clarke said that Specialty Gas uses about 50,000 lb/yr of 88/12 Freon/EO sterilizing gas.

CONFIRMATION	11-13-87
RESPONSE	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

RECEIVED 11-13-87

4-88-03
RECEIVED 8-03

CONTACT REPORT--MRI Project No. 7723-K

II E 291
 AUG 26 1997

From: Vicki M. Soltis, Environmental Engineer, O&PS AIR
 Date of Contact: 3/11/87
 Contacted by: Telephone
 Company/Agency: Abbott Laboratories
 Building AP4 Abbott Park
 North Chicago, Illinois 60064
 Telephone Number: (312) 937-7416

DOCKET CONTROL ROOM

CONFIRMATION requested 3/11/88
RESPONSE rec'd 3/17/88
revised per comments
WRITTEN <input type="checkbox"/> VERBAL <input checked="" type="checkbox"/> NONE <input type="checkbox"/>

Person(s) Contacted/Title(s)

Lawrence H. Hecker, Ph.D., Director, Corporate Industrial Hygiene and Toxicology

CONTACT SUMMARY:

Dr. Hecker was contacted for additional information about the ethylene oxide emission control devices reported on the 1985 HIMA survey. The information received from Dr. Hecker is summarized for each facility below.

Facility No. 1, Barceloneta, Puerto Rico--A custom-design water scrubber with an estimated control efficiency of 98 percent was reported. This efficiency estimate considers only the stack as a source of atmospheric ethylene oxide emissions, i.e., 2 percent of the emissions are emitted from the stack, and 98 percent of the ethylene oxide enters the drain. No chemicals are used to convert ethylene oxide to ethylene glycol.

Facility No. 2, Salt Lake City, Utah--A custom-design water cyclone with an estimated control efficiency of 20 percent was reported. Again, this efficiency considers only the stack as a source of atmospheric pollutants, i.e., 80 percent of the emissions are emitted from the stack; 20 percent enter the drain. Testing performed since the time of the survey showed that 20 percent of the emissions are emitted from the stack and 80 percent enter the drain. The numbers reported during the survey were estimated. No chemicals are used to convert ethylene oxide to ethylene glycol.

Facility No. 3, Laurinburg, North Carolina--A flare with a control efficiency of 99.7 percent based on the manufacturer's specifications was reported. Subsequent tests showed an efficiency of 99.9 percent, with four of the five test results showing an efficiency greater than 99.9 percent.

Facility No. 4, Rocky Mount, North Carolina--A caustic scrubber and decontamination pit with efficiencies of 30 percent for sterilizer No. 1 and 95 percent for sterilizer No. 2 were reported. These efficiencies were accurate at the time of the survey. However, in June of 1986, equipment changes were made and both sterilizers now are controlled at 95 percent.

Facility No. 5, North Chicago, Illinois--a water scrubber with an estimated control efficiency of 50 percent was reported. The effluent from the scrubber enters Abbott's chemical sewer for treatment at their chemical treatment plant.

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II E 292

TELEPHONE CONVERSATION SUMMARY AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOMCaller: Scott RossDate: 7-22-87

Name of Person:

Carl Falco
~~John Smith - Jim Burnette, Assistant~~

His/Her Title:

Assistant Pesticide Administrator

Telephone No.:

(919) 733-3556

Organization/Company:

NC Pest Control Division - Dept. of Agriculture

Address:


State Agriculture BuildingRaleigh, North Carolina 27611

Subject of Conversation:

Vikane (Sulfuruy1 Flouride)

Summary:

- * Jim Burnette Assistant Pesticide Administrator
- * Restricted pesticide
- * Certified Applicator
- * Ray Hovell - Structural Pesticides Division 733-6100
- * Call Thursday Carl Falco
- * Call Friday Med Dillon
- * Vikane Dow chemical, Charlotte - Bruce Sevenser (704) 289-2732
- * Certified Applicator - examination in phases for care manuals fumigation and law books
- * Not regulated as far as emissions go

Signature: 

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AUG 23 1997 E 293

TELEPHONE CONVERSATION SUMMARY

OAQPS AIR
DOCKET CONTROL ROOM

Caller: Scott Ross

Date: 7-22-87

Name of Person: Ivan Hanthorn

His/Her Title: Conservation Specialist

Telephone No.: (515) 294-8858

Organization/Company: Parks Library

Address: Iowa State University

Ames, IA

Subject of Conversation: EO use, things fumigated, substitutes, Vikane,
operating budget, number of employees

Summary:

- * Books & manuscripts - suspect backgrounds
- * Do nothing as an alternative - no attempt to fumigate
- * Not informed on all alternatives
- * Freezing solves insect threat, doesn't kill fungi.
- * Vikane - high corrosive capacity corrodes exhaust piping of stainless steel.
- * Only corrodes metals.
- * 220 employees
- * Call directors at 294-1442
Office Miss. Gross - call Thursday at 9:30
- * Librarians went to find other things than EO - but not convinced that anything else

Signature: *Scott Ross*

CONTACT REPORT--MRI Project No. 8692-16
AUG 2 3 1997

II E 294

From: Lee Humphrey, Environmental Engineering Department

Date of Contact: July 23, 1987

Contacted by: Telephone

Company/Agency: Castle-Sybron
1777 East Henrietta Road
Rochester, New York 14692

Telephone Number: (716) 272-5080

Person(s) Contacted/Title(s)

Mr. Charlie Hancock, Manager of Process and Equipment Development

CONFIRMATION	Sent 7/29/87
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input checked="" type="checkbox"/>	

CONTACT SUMMARY:

Mr. Hancock was asked about the manufacturing of hospital sterilization chambers. He informed me that sterilization with 10/90 (EO/CO₂) can be done in the same chamber as sterilization with 12/88 (EO/CFC-12). The chambers are designed to operate at up to 40 pounds of pressure (gauge?) but actually operate at around 8 pounds. He did not have any information on which types of products cannot be sterilized with 10/90. Mr. Hancock felt that the life of a chamber should be a minimum of 10 years, but, with proper maintenance, the chamber should last indefinitely. Castle-Sybron manufactures chambers that range in size from a 20-inch square opening by 2 feet deep to a 1,352-inch square (26 inch by 52 inch) opening by 9 feet deep. These range in price from \$20,000 to \$100,000. Hospitals cannot use pure EO or sterilant gases other than 10/90 or 12/88 in their sterilizers without modifications because the valve fittings are not compatible to those types of cylinders. They use 12/88 because it is a nonexplosive sterilant mixture. Mr. Hancock informed me that hospitals rarely used to use 10/90 but preferred 12/88 because it is nonexplosive. Growth in the sterilizer industry is almost totally associated with demographics. Exports (mainly to Canada) represent only a very small part of their sales because the United States is not on the metric system.

CONTACT REPORT--MRI Project No. 8692-16

RECEIVED JUN 11 1988
II E 295

From: Lee Humphrey, Environmental Engineering Department

Date of Contact: July 23, 1987

Contacted by: Telephone

Company/Agency: Central Carolina Hospital
1135 Carthage Street
Sanford, North Carolina 27330

Telephone Number: (919) 774-2100

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OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Mr. Joe Delvecchio, Director of Engineering

CONTACT SUMMARY:

Mr. Delvecchio was asked about the hospital's sterilization chamber that, according to a Section 114 response completed August 1986, reportedly uses 10/90 (EO/CO₂). He informed me that they currently use 12/88 (EO/CFC-12) and, as far as he knew, that is the only mixture they have ever used. The hospital has never had to replace the chamber which is 2 years old. Mr. Delvecchio felt that with proper maintenance the chamber should last at least 30 years. He did not have any information on the costs to sterilize one load or on chamber operating pressures. He did not have any information on the types of materials that could not be sterilized. Mr. Delvecchio also informed me that they have three people whose ~~only~~ job is to operate the sterilizers. They aerate sterilized material for 24 hours.

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 8/6/87

Contacted by: Telephone

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Company/Agency: Lederle Laboratories
Division of American Cyanamid
N. Middletown Road
Pearl River, New York 10965

AUG 26 1987

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (914) 735-5000, ext. 2909

Person(s) Contacted/Title(s)

Janet Regan

CONTACT SUMMARY:

I asked Ms. Regan if the control unit (catalytic oxidizer) at Lederle Labs runs continuously. She said that it runs for about 12 hours a day and all of the gas (both aeration room and sterilization chamber spent gas) is routed through this device. Sterilized items are removed from the aeration room prior to shutting down the control unit.

CONFIRMATION	<u>Received</u>
	<u>3/9/88</u>
RESPONSE	
	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> NONE

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 9/17/87

Contacted by: Telephone

Company/Agency: Chemrox, Inc.
217 Long Hill Crossroads
Shelton, Connecticut 06484

Telephone Number: (203) 926-9081

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AUG 28 1987

OAGPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Ahmed Allawi/Manager, Process Engineering

CONTACT SUMMARY:

Mr. Allawi was asked about emissions monitoring of ethylene oxide at sterilization facilities using the Chemrox scrubber. He mentioned the testing MRI did at Chemrox to determine the efficiency of hospital-sized scrubbers; he said that those types of tests are the only "techniques" he knows of for emissions monitoring. When asked about how a facility can be assured that EO is being converted to ethylene glycol, Mr. Allawi said that each piece of equipment has its own checks, i.e., pH meter, pressure gauges, thermocouples, etc. An alarm will be activated when it is time to regenerate. (A level indicator is used to determine when the solution has reached 40 weight percent ethylene glycol.) He also said that the pH does not change, but that it possibly could if H₂O condensate was present. A large quantity of condensate is required, however, to change the pH of the solution appreciably. This is not encountered under most sterilizer operating conditions and he does not know of this ever happening and thinks it unlikely.

Mr. Allawi was asked about the efficiency of the scrubber after it has reached 40 weight percent ethylene glycol. He said that they (Chemrox) had performed tests on this matter and found that the efficiency declines after 60 weight percent ethylene glycol. The DEOXX™ system can be designed to achieve any ethylene oxide removal efficiency. The "normal" design requires 99 percent removal (by weight) at 40 percent ethylene glycol. For this case, Chemrox has found that the removal efficiency declines rapidly only after the solution reaches the 60 percent ethylene glycol level. He said that most facilities would have fairly regular regeneration schedules and would realize something was wrong if the alarm was not activated.

CONFIRMATION <u>March 21, 1988</u>
RESPONSE _____
WRITTEN <input checked="" type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input type="checkbox"/>

CONTACT REPORT--MRI Project No. 8950-⁰⁵~~50~~

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 10/22/87, 10/23/87

Contacted by: Telephone

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Company/Agency: National Welders Supply Company, Inc.
Raleigh, North Carolina

AUG 26 1997

Telephone Number: (919) 876-6710

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Spence Acock

CONTACT SUMMARY:

I called Mr. Acock on October 22 to find out if his company sold ethylene oxide gas mixtures and what these gas mixtures cost. He called me back the next day and gave me the following information:

Cost of 60 lb cylinder of 10/90: \$65.00

Cost of 140 lb cylinder of 12/88: \$154.22

Mr. Acock said that his company has branches all over North Carolina and that they sell the 12/88 gas mostly to hospitals. He did not know what types of companies bought the 10/90 gas mixture. He said that although his company does supply 10/90 he does not recall receiving many (if any) orders for 10/90. He also said that his company receives the ethylene oxide from "vendors."

From: David Johnson, Environmental Engineering Department
Date of Contact: 10/30/87
Contacted by: Telephone
Company/Agency: Johnson & Johnson International
One Johnson & Johnson Plaza
New Brunswick, New Jersey 08933
Telephone Number: (201) 524-5483

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AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Miron G. Popescu, Technical Advisor

CONTACT SUMMARY:

I talked briefly with Mr. Popescu about the automatic monitoring capabilities of the Damas ethylene oxide (EO) scrubber and methods for assuring that this unit is operating efficiently. Mr. Popescu stated that, while the Damas unit has a pH monitor, the pH of the scrubbing solution is not a very good indicator of the operating efficiency of the unit. He indicated that the ideal monitoring operation would consist of a gas chromatograph (GC) capable of determining the EO concentration of the scrubber offgas at desired intervals. Monitoring the scrubber offgas with a GC is not feasible, however, because of the relative high cost (\$40,000 to \$45,000) of starting up a GC and the problems associated with operating a GC under such extreme conditions (e.g., frequent clogging of the columns, etc.).

In order to verify that the Damas scrubber was operating properly (i.e., greater than 99 percent EO destruction efficiency) Johnson & Johnson hired an outside contractor to conduct tests on a Damas unit at one of their facilities. Mr. Popescu stated that more than 20 tests were conducted at 2-week intervals to determine the mass flow of EO at the inlet and outlet of the unit. Provisions were also made to measure the amount of ethylene glycol (EG) in the scrubbing solution. He stated that the scrubber was still operating at approximately 99.1 percent efficiency when the EG concentration of the scrubbing liquor had reached 60 percent. For the Damas Model 200 scrubber, this EG concentration will occur when approximately 4,000 pounds of EO have been processed. Mr. Popescu said he would be glad to send me a copy of the test results.

Mr. Popescu stated that the Damas unit is equipped with an instrument that measures the specific density of the scrubbing solution. When the specific density reaches a certain point, indicating that the solution consists of 60 percent EG, the instrument alerts the operators that the scrubbing solution should be replaced. Operators are also instructed to keep up with the amount of EO that enters the scrubber, and replace the solution when a certain amount has been processed.

Damas Model 200

1987 SCRUBBER EFFICIENCY STUDY

DATE	LBS. OF ETO	pH	H ₂ SO ₄ NORMALITY	DENSITY	% WATER	% ETHYLENE GLYCOL	% DIETHYLENE GLYCOL	% TRIETHYLENE GLYCOL	UNKNOWN PEAKS	% TOTAL GLYCOL	LIQUID LEVEL INCHES	SCRUBBER REMOVAL EFFICIENCY
01/30	0	1.18	—	1.057	90.3	1.0	—	—	—	—	46-3/4	—
02/02	117	1.12	—	1.060	87.0	3.2	—	—	—	—	48-1/2	99.74
02/11	320	1.21	—	1.069	81.1	9.4	—	—	—	—	51-1/2	99.71
02/17	444	1.20	—	1.067	77.0	11.6	—	—	—	—	53-3/4	—
02/25	646	1.41	1.26	1.080	72.3	17.4	—	—	—	—	58	99.97
03/04	784	1.32	2.0	1.103	66.8	18.8	—	—	—	—	*48-1/2	—
*03/11	982	1.29	1.91	1.108	63.6	20.6	—	—	—	—	50-3/4	99.93
03/17	1,137	1.23	1.97	1.117	59.3	23.3	—	—	—	—	52-3/4	—
03/25	1,354	1.38	1.83	1.111	50.9	26.6	—	—	—	—	54-1/4	99.80
03/31	1,510	1.33	1.73	1.112	48.0	29.7	—	—	—	—	56-3/4	—
04/07	1,704	1.28	1.63	1.113	46.6	30.9	—	—	—	—	56-1/2	99.83
04/14	1,882	1.25	1.55	1.127	44.1	32.6	—	—	—	—	58	—
04/22	2,060	1.14	1.55	1.120	43.0	33.0	—	—	—	—	59	99.90
04/28	2,226	1.12	1.50	1.127	40.9	35.6	—	—	—	—	59-1/2	—
*05/06	2,361	0.6	1.44	1.134	37.0	30.8	17.2	5.6	1	53.6	*51	99.53
05/13	2,550	0.48	1.59	1.139	35.9	30.1	18.3	6.3	1	54.7	52-1/2	—
05/20	2,721	0.46	1.55	1.139	31.7	31.0	20.0	6.6	1	57.6	43-3/4	99.45
05/29	2,864	0.46	1.50	1.139	33.6	33.1	18.8	6.5	1	58.4	55	—
06/04	2,936	0.44	1.47	1.139	33.9	29.0	19.2	6.9	1	55.1	56-3/4	—
06/11	3,063	0.45	1.46	1.138	33.4	25.3	20.4	7.9	1	53.6	59	99.62
06/19	3,174	0.47	1.44	1.139	31.7	27.3	22.1	8.2	2	57.6	59-1/3	—
06/29	3,473	0.44	1.36	1.135	30.7	24.9	21.5	7.9	2	54.3	60-1/2	—
07/02	3,519	0.45	2.36	1.127	30.3	23.9	34.5	9.4	2	57.8	60-3/4	99.29
07/07	3,563	0.44	1.34	1.139	29.7	29.8	23.3	9.0	2	62.0	*49-3/4	—
07/16	3,777	0.65	1.33	1.105	27.2	27.4	19.7	13.7	2	60.6	—	—

hcb/0425x/1



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

A-88-03

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AUG 2 1997

OAQPS AIR
DOCKET CONTROL ROOM

MEMORANDUM

SUBJECT: Working Group Meeting--National Emission Standard for Hazardous Air Pollutants (NESHAP) for Commercial Sterilization NESHAP Project

FROM: Robert Rosensteel
Work Group Chairman (MD-13)

TO: See Below

We have scheduled a Working Group meeting for 9:30 a.m. to 12:00 noon on November 13, 1987, in the Hall of States, Room B at the Best Western Skyline Inn (South Capitol and I Street). At this meeting we plan to discuss regulatory options for the ethylene oxide (EO) commercial sterilization NESHAP.

A copy of the meeting agenda and a copy of the preliminary regulatory options analysis are attached. These options were selected from a series of regulatory options based on using both chamber size and EO use as criteria for cutoffs.

Please review the attached material before the Working Group meeting so we can discuss possible regulatory options. We would appreciate your attendance. If you cannot attend the meeting, please have a representative from your office attend. If you have any questions concerning the meeting or the attached material, please call me at FTS 629-5608 or David Markwordt at FTS 629-5411.

Attachment

Addressees:

Richard Biondi, SSCD (EN-341)
Karen Brown, SBO (A-149C)
Pat Embrey, OGC (LE-132A)
Charlie Garlow, OECM (LE-134P)
John Margeson, EMSL (MD-77A)
Neil Patel, OPD (ANR-445)
Paul Shapiro, OEETD (RD-681)
Vivian Thomson, OPAR (ANR-443)
Bruce Varner, Region V
Walt Waldrop, OPTS (TS-767C)

cc: Bob Ajax (MD-13)
Doug Bell (MD-13)
Laura Butler (MD-13)
John Calcagni (MD-12)
Ron Campbell (MD-10)
John O'Connor (MD-12)
Bob Schell (MD-12)
Tom Walton (MD-12)
Susan Wyatt (MD-13)

AGENDA--WORKING GROUP MEETING NO. 2
November 13, 1987

COMMERCIAL STERILIZATION
PRELIMINARY REGULATORY OPTIONS ANALYSIS

I. INTRODUCTION

- A. Since the first WG meeting, OPAR and SSCD have expressed a preference for the combination chamber size and EO use cutoff as the criterion for developing regulatory options
- B. Therefore, the following analysis is based on a combination of total chamber size and EO use cutoffs

II. PURPOSE OF MEETING

Initiate the regulatory option selection process

III. PRELIMINARY REGULATORY OPTIONS ANALYSIS

- A. Sample preliminary regulatory options (Table 1)
- B. Graphs of following correlations:
 - 1. Annualized costs vs. incidence reduction
 - 2. Percent people at risk $\geq 10^{-4}$ vs. incidence reduction

IV. APPENDICES

- A. Working tables
- B. Data bases

V. PURPOSE OF NEXT MEETING

Recommend an option that will be the basis of the standard

TABLE 1.

SAMPLE PRELIMINARY
REGULATORY OPTIONS

DESCRIPTION OF SELECTED OPTION	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	ED USE CUTOFF (lb/yr)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (\$MM)	AVERAGE COST/CASE (\$MM)	INCREMENTAL COST/CASE (\$MM)	HIGHEST NIR BELOW CUTOFF	PEOPLE AT RISK $\geq 10(-4)$ [thousands]	PEOPLE AT RISK $\geq 10(-5)$ [thousands]	PEOPLE AT RISK $\geq 10(-6)$ [thousands]	NUMBER OF FACILITIES ABOVE CUT	CONTROL OPTION NUMBER
ALL FACILITIES CONTROLLED	0	0	2.86	100.00	6.62	2.31		0.00000	1.7	87	1700	191	1
STARTING POINT OPTION	400	5000	2.82	98.46	5.03	1.78	39.75	0.00030	2.0	99	1900	123	26
1% INCREASE IN PEOPLE AT RISK $\geq 10(-4)$ FROM STARTING POINT	500	40000	2.76	96.35	4.60	1.67	7.17	0.00064	3.2	120	2300	106	41
OPTION ACHIEVES 95% INCIDENCE REDUCTION	600	10000	2.72	95.11	4.37	1.61	5.75	0.00052	3.6	130	2600	99	43
2% INCREASE IN PEOPLE AT RISK $\geq 10(-4)$ FROM STARTING POINT	600	35000	2.69	93.93	4.20	1.58	4.33	0.00064	4.3	140	2900	93	48
LEAST STRINGENT WITH ZERO PEOPLE AT RISK $\geq 10(-3)$	1000	20000	2.62	91.49	3.75	1.43	7.00	0.00080	5.8	190	3400	77	77
OPTION SO THAT NO FACILITY $\geq 7MM/LIFE$ IS INCLUDED	7400	241000	0.41	14.17	0.12	0.29	1.64	0.010	94	2000	30000	4	f
BASELINE	--	--	0.00	0.00	0.00	--	0.29	0.010	120	2300	35000	0	--

a The control option numbers represent options selected from the table for combination chamber size and E0 use exemptions.

b The number of additional people exposed to $\geq 10^{-4}$ for this option, as compared to the starting point (Option 26), is equivalent to about 1 percent of the total people exposed at baseline to $\geq 10^{-4}$.

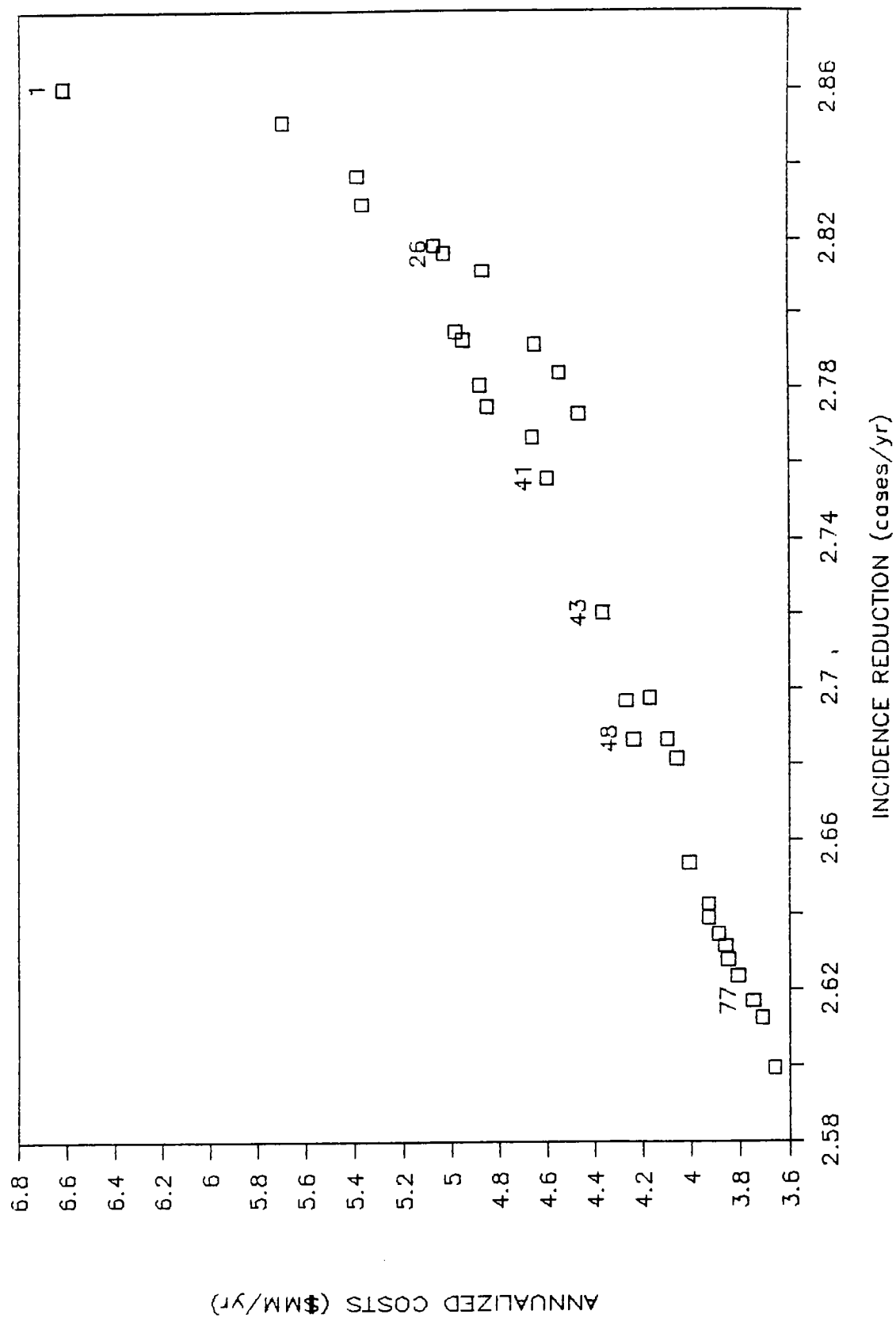
c The most stringent option with equivalent regulatory impacts was chosen.

d The number of additional people exposed to $\geq 10^{-4}$ for this option, as compared to the starting point (Option 26), is equivalent to about 2 percent of the total people exposed at baseline to $\geq 10^{-4}$.

e For this option, the number of people exposed to $\geq 10^{-4}$ is 100 percent of baseline (2 out of 2); the number of people exposed to $\geq 10^{-5}$ is 70 percent of baseline (2,675 out of 3,797). (The percent of people at risk $\geq 10^{-5}$ is equal to 0 percent of baseline for all other options listed in this table.)

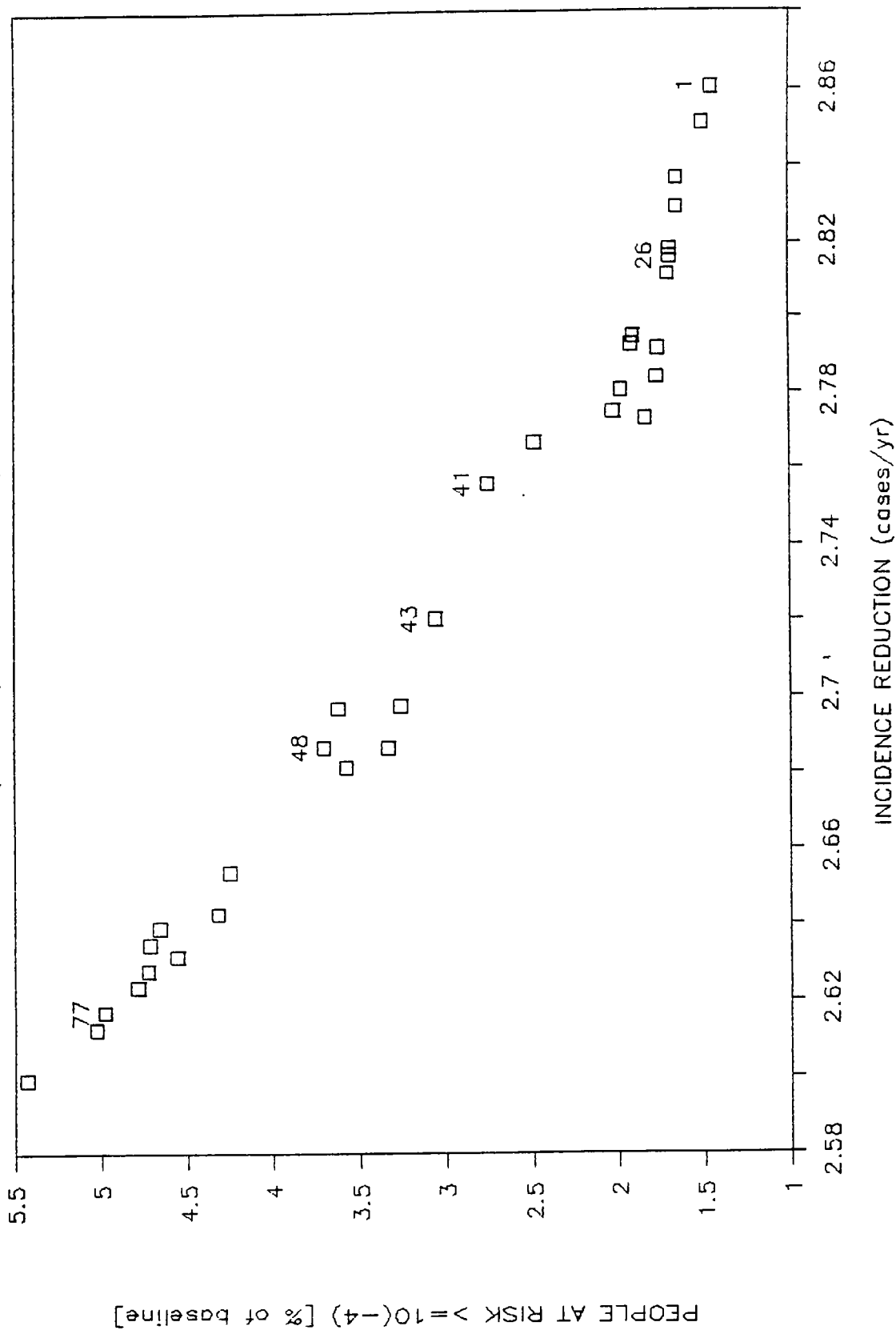
f An exemption equivalent to this option was not prepared for the table for the combination chamber size and E0 use exemptions.

ANNUAL COST VS. INCIDENCE REDUCED



% PEOPLE $\geq 10(-4)$ VS. INCID. REDUCED

(as compared to baseline)



APPENDIX A.
WORKING TABLES

NOTES FOR TABLES A-1, A-1a, A-1b, AND A-1c

1. For Tables A-1, A-1a, A-1b, and A-1c, a facility would be covered by the regulation (1) if the total chamber size is equal to or greater than the chamber size cutoff or (2) if the EO use is equal to or greater than the EO use cutoff. (See the columns labeled [1] on Tables A-1, A-1a, A-1b, and A-1c.)
2. The emission reduction (column 2, Table A-1) was calculated assuming that for NESHAP-level control (1) vent and drain emissions are controlled at 99 percent and (2) aeration room emissions are uncontrolled.
3. The incidence reduction (column 4, Table A-1) represents the reduction under NESHAP-level control. Therefore, the incidence attributed to aeration rooms, which would remain uncontrolled, is not included.
4. Within each chamber size cutoff, the incremental cost/case (column 9, Table A-1) and incremental cost effectiveness (column 3, Table A-1b) represent the difference in annual cost divided by the difference in incidence reduction (or emission reduction) between the given option and the one above it.
5. The cost-effectiveness (CE) index (column 10) refers to the percentage of the total annualized cost (column 6) allocated to control facilities with dollar-per-case values greater than \$8 million. (See Table A-1a for a breakdown of the number of facilities with high dollar-per-case estimates.)
6. Columns 12, 13, and 14 (Table A-1) indicate the number of facilities exempted from regulation that have baseline MIR's greater than 10^{-3} , 10^{-4} , and 10^{-5} , respectively.
7. Column 15 (Table A-1) shows the highest baseline MIR associated with a facility that is exempted from the regulation.
8. In Table A-1c, the population numbers (Columns 2 through 6) refer to the total number of people exposed to each risk level due to
 - (1) baseline vent and drain emissions from exempted facilities,
 - (2) controlled vent and drain emissions from covered facilities, and
 - (3) uncontrolled aeration room emissions from all facilities.

TABLE A-1.
COMBINATION OF
TOTAL CHAMBER SIZE
AND ETHYLENE OXIDE
USE EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	ED USE CUTOFF (lb/yr)	EMISSION REDUCTION (kg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	ANNUALIZED COSTS (% of total)	AVERAGE COST/CASE (\$/HM)	INCREMENTAL COST/CASE (\$/HM)	CE INDEX (%)	NUMBER OF FACILITIES >80MW/LIFE	NUMBER BELOW CUTOFF WITH MIR >10(-3)	NUMBER BELOW CUTOFF WITH MIR >10(-4)	NUMBER BELOW CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT	CONTROL OPTION NUMBER
0	0	1753.072	100.00	2.8603	100.00	6.62	100.00	2.31		50	107	0	0	0	0.00000000	191	1
100	5000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	98.92	42	68	0	2	10	0.00014100	152	2
100	10000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	3
100	15000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	4
100	20000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	5
100	25000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	6
100	30000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	7
100	35000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	8
100	40000	1747.515	99.68	2.8510	99.67	5.70	86.10	2.00	0.00	42	68	0	2	10	0.00014100	152	9
200	5000	1741.433	99.34	2.8369	99.18	5.39	81.42	1.90	52.56	39	57	0	3	19	0.00029700	139	10
200	10000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	2.60	39	57	0	3	19	0.00029700	139	11
200	15000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	0.00	39	57	0	3	19	0.00029700	139	12
200	20000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	0.00	39	57	0	3	19	0.00029700	139	13
200	25000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	0.00	39	57	0	3	19	0.00029700	139	14
200	30000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	0.00	39	57	0	3	19	0.00029700	139	15
200	35000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	0.00	39	57	0	3	19	0.00029700	139	16
200	40000	1739.190	99.21	2.8292	98.91	5.37	81.12	1.90	0.00	39	57	0	3	19	0.00029700	139	17
300	5000	1734.156	98.92	2.8184	98.54	5.07	76.59	1.80	36.99	36	44	0	6	29	0.00029700	125	18
300	10000	1724.201	98.35	2.7947	97.71	4.98	75.23	1.78	3.80	36	43	0	9	32	0.00040000	121	19
300	15000	1719.674	98.09	2.7924	97.63	4.95	74.77	1.77	13.04	36	42	0	10	33	0.00044400	120	20
300	20000	1719.674	98.09	2.7924	97.63	4.95	74.77	1.77	0.00	36	42	0	10	33	0.00044400	120	21
300	25000	1719.674	98.09	2.7924	97.63	4.95	74.77	1.77	0.00	36	42	0	10	33	0.00044400	120	22
300	30000	1719.674	98.09	2.7924	97.63	4.95	74.77	1.77	0.00	36	42	0	10	33	0.00044400	120	23
300	35000	1719.674	98.09	2.7924	97.63	4.95	74.77	1.77	0.00	36	42	0	10	33	0.00044400	120	24
300	40000	1719.674	98.09	2.7924	97.63	4.95	74.77	1.77	0.00	36	42	0	10	33	0.00044400	120	25
400	5000	1732.251	98.81	2.8163	98.46	5.03	75.98	1.79	36.14	35	42	0	7	32	0.00044400	120	26
400	10000	1715.225	97.84	2.7807	97.22	4.88	73.72	1.75	4.21	35	40	0	12	36	0.00051600	117	27
400	15000	1708.568	97.46	2.7749	97.01	4.85	73.26	1.75	5.17	35	39	0	14	38	0.00051600	115	28
400	20000	1708.568	97.46	2.7749	97.01	4.85	73.26	1.75	0.00	35	39	0	14	38	0.00051600	115	29
400	25000	1708.568	97.46	2.7749	97.01	4.85	73.26	1.75	0.00	35	39	0	14	38	0.00051600	115	30
400	30000	1708.568	97.46	2.7749	97.01	4.85	73.26	1.75	0.00	35	39	0	14	38	0.00051600	115	31
400	35000	1708.568	97.46	2.7749	97.01	4.85	73.26	1.75	0.00	35	39	0	14	38	0.00051600	115	32
400	40000	1708.568	97.46	2.7749	97.01	4.85	73.26	1.75	0.00	35	39	0	14	38	0.00051600	115	33
500	5000	1727.852	98.56	2.8116	98.30	4.87	73.56	1.73	35.93	33	36	0	9	35	0.00064400	117	34
500	10000	1706.207	97.33	2.7667	96.73	4.66	70.39	1.68	4.68	33	34	0	16	42	0.00064400	109	35
500	15000	1694.325	96.65	2.7560	96.35	4.60	69.49	1.67	5.61	33	33	0	19	45	0.00064400	106	36
500	20000	1694.325	96.65	2.7560	96.35	4.60	69.49	1.67	0.00	33	33	0	19	45	0.00064400	106	37
500	25000	1694.325	96.65	2.7560	96.35	4.60	69.49	1.67	0.00	33	33	0	19	45	0.00064400	106	38
500	30000	1694.325	96.65	2.7560	96.35	4.60	69.49	1.67	0.00	33	33	0	19	45	0.00064400	106	39
500	35000	1694.325	96.65	2.7560	96.35	4.60	69.49	1.67	0.00	33	33	0	19	45	0.00064400	106	40
500	40000	1694.325	96.65	2.7560	96.35	4.60	69.49	1.67	0.00	33	33	0	19	45	0.00064400	106	41
600	5000	1719.786	98.10	2.7914	97.59	4.65	70.24	1.67	28.59	31	31	0	13	42	0.00029700	110	42
600	10000	1690.199	96.41	2.7204	95.11	4.37	66.01	1.61	3.94	31	28	0	23	52	0.00051600	99	43
600	15000	1669.882	95.25	2.6970	94.29	4.27	64.50	1.58	4.27	31	27	0	28	57	0.00064400	94	44
600	20000	1661.738	94.79	2.6866	93.93	4.24	64.05	1.58	2.88	32	27	0	29	58	0.00064400	93	45

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A2

TABLE A-1. (continued)

COMBINATION OF
TOTAL CHAMBER SIZE
AND ETHYLENE OXIDE
USE EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	EMISSION REDUCTION (Mg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	ANNUALIZED COSTS (% of total)	AVERAGE COST/CASE (\$MM)	INCREMENTAL COST/CASE (\$MM)	CE INDEX (%)	NUMBER OF FACILITIES >8MM/LIFE	NUMBER BELOW CUTOFF WITH MIR >10(-3)	NUMBER BELOW CUTOFF WITH MIR >10(-4)	NUMBER WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT	CONTROL OPTION NUMBER
600	25000	1661.738	94.79	2.6866	93.93	4.24	64.05	1.58	0.00	32	27	0	29	58	0.00064400	93	46
600	30000	1661.738	94.79	2.6866	93.93	4.24	64.05	1.58	0.00	32	27	0	29	58	0.00064400	93	47
600	35000	1661.738	94.79	2.6866	93.93	4.24	64.05	1.58	0.00	32	27	0	29	58	0.00064400	93	48
700	5000	1715.372	97.85	2.7840	97.33	4.55	68.73	1.63	27.13	30	29	0	14	46	0.00029700	105	50
700	10000	1676.490	95.63	2.6977	94.32	4.17	62.99	1.55	4.40	30	24	0	27	59	0.00051600	91	51
700	15000	1645.226	93.85	2.6539	92.78	4.01	60.57	1.51	3.65	30	23	0	34	66	0.00064400	84	52
700	20000	1630.427	93.00	2.6392	92.27	3.93	59.37	1.49	5.44	30	22	0	36	68	0.00080100	82	53
700	25000	1621.366	92.49	2.6347	92.11	3.89	58.76	1.48	8.89	29	21	1	37	69	0.00122000	81	54
700	30000	1621.366	92.49	2.6347	92.11	3.89	58.76	1.48	0.00	29	21	1	37	69	0.00122000	81	55
700	35000	1621.366	92.49	2.6347	92.11	3.89	58.76	1.48	0.00	29	21	1	37	69	0.00122000	81	56
800	5000	1712.465	97.68	2.7729	96.94	4.47	67.52	1.61	24.60	30	28	0	15	48	0.00029700	103	58
800	10000	1673.583	95.47	2.6866	93.93	4.10	61.93	1.53	4.29	29	23	0	28	61	0.00051600	89	59
800	15000	1642.319	93.68	2.6428	92.40	3.93	59.37	1.49	3.88	30	22	0	35	68	0.00064400	82	60
800	20000	1627.520	92.84	2.6281	91.88	3.85	58.16	1.46	5.44	29	21	0	37	70	0.00080100	80	61
800	25000	1618.459	92.32	2.6236	91.72	3.81	57.55	1.45	8.89	29	20	1	38	71	0.00122000	79	62
800	30000	1618.459	92.32	2.6236	91.72	3.81	57.55	1.45	0.00	29	20	1	38	71	0.00122000	79	63
800	35000	1618.459	92.32	2.6236	91.72	3.81	57.55	1.45	0.00	29	20	1	38	71	0.00122000	79	64
900	5000	1712.465	97.68	2.7729	96.94	4.47	67.52	1.61	24.60	30	28	0	15	48	0.00029700	103	65
900	10000	1670.448	95.29	2.6814	93.75	4.06	61.33	1.51	4.48	30	23	0	29	62	0.00051600	88	66
900	15000	1633.041	93.15	2.6317	92.01	3.86	58.31	1.47	4.02	31	22	0	36	70	0.00064400	80	68
900	20000	1610.449	91.86	2.6170	91.49	3.75	56.65	1.43	7.48	29	20	0	38	72	0.00080100	77	69
900	25000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	8.89	29	19	1	39	73	0.00122000	76	70
900	30000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	0.00	29	19	1	39	73	0.00122000	76	71
900	35000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	0.00	29	19	1	39	73	0.00122000	76	72
900	40000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	0.00	29	19	1	39	73	0.00122000	76	73
1000	5000	1712.465	97.68	2.7729	96.94	4.47	67.52	1.61	24.60	30	28	0	15	48	0.00029700	103	74
1000	10000	1670.448	95.29	2.6814	93.75	4.06	61.33	1.51	4.48	30	23	0	29	62	0.00051600	88	75
1000	15000	1633.041	93.15	2.6317	92.01	3.86	58.31	1.47	4.02	31	22	0	36	70	0.00064400	80	76
1000	20000	1610.449	91.86	2.6170	91.49	3.75	56.65	1.43	7.48	29	20	0	38	72	0.00080100	77	77
1000	25000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	8.89	29	19	1	39	73	0.00122000	76	78
1000	30000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	0.00	29	19	1	39	73	0.00122000	76	79
1000	35000	1601.388	91.35	2.6125	91.34	3.71	56.04	1.42	0.00	29	19	1	39	73	0.00122000	76	80
1000	40000	1586.440	90.49	2.5993	90.88	3.66	55.29	1.41	3.79	29	19	1	40	74	0.00122000	75	81
(11)					(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)

TABLE A-1a.
NUMBER OF HIGH-COST
FACILITIES FOR THE
COMBINATION CHAMBER
SIZE AND EO USE EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	NUMBER OF FACILITIES ABOVE CUTOFF >\$8MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$15MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$25MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$50MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$100MM/CASE	CONTROL OPTION NUMBER
0	0	107	84	71	60	51	1
100	5000	68	47	36	25	18	2
100	10000	68	47	36	25	18	3
100	15000	68	47	36	25	18	4
100	20000	68	47	36	25	18	5
100	25000	68	47	36	25	18	6
100	30000	68	47	36	25	18	7
100	35000	68	47	36	25	18	8
100	40000	68	47	36	25	18	9
200	5000	57	36	26	16	12	10
200	10000	57	36	26	16	12	11
200	15000	57	36	26	16	12	12
200	20000	57	36	26	16	12	13
200	25000	57	36	26	16	12	14
200	30000	57	36	26	16	12	15
200	35000	57	36	26	16	12	16
200	40000	57	36	26	16	12	17
300	5000	44	26	17	10	7	18
300	10000	43	26	17	10	7	19
300	15000	42	26	17	10	7	20
300	20000	42	26	17	10	7	21
300	25000	42	26	17	10	7	22
300	30000	42	26	17	10	7	23
300	35000	42	26	17	10	7	24
300	40000	42	26	17	10	7	25
400	5000	42	25	16	9	6	26
400	10000	40	25	16	9	6	27
400	15000	39	25	16	9	6	28
400	20000	39	25	16	9	6	29
400	25000	39	25	16	9	6	30
400	30000	39	25	16	9	6	31
400	35000	39	25	16	9	6	32
400	40000	39	25	16	9	6	33
500	5000	36	21	12	5	3	34
500	10000	34	21	12	5	3	35
500	15000	33	21	12	5	3	36
500	20000	33	21	12	5	3	37
500	25000	33	21	12	5	3	38
500	30000	33	21	12	5	3	39
500	35000	33	21	12	5	3	40
500	40000	33	21	12	5	3	41
600	5000	31	17	9	4	3	42
600	10000	28	17	9	4	3	43
600	15000	27	17	9	4	3	44
600	20000	27	17	9	4	3	45

(1)

TABLE A-1a. (continued)

NUMBER OF HIGH-COST
FACILITIES FOR THE
COMBINATION CHAMBER
SIZE AND ED USE EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	ED USE CUTOFF (lb/yr)	NUMBER OF FACILITIES ABOVE CUTOFF >\$8MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$15MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$25MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$50MM/CASE	NUMBER OF FACILITIES ABOVE CUTOFF >\$100MM/CASE	CONTROL OPTION NUMBER
600	25000	27	17	9	4	3	46
600	30000	27	17	9	4	3	47
600	35000	27	17	9	4	3	48
600	40000	27	17	9	4	3	49
700	5000	29	15	7	2	2	50
700	10000	24	14	7	2	2	51
700	15000	23	14	7	2	2	52
700	20000	22	14	7	2	2	53
700	25000	21	14	7	2	2	54
700	30000	21	14	7	2	2	55
700	35000	21	14	7	2	2	56
700	40000	21	14	7	2	2	57
800	5000	28	15	7	2	2	58
800	10000	23	14	7	2	2	59
800	15000	22	14	7	2	2	60
800	20000	21	14	7	2	2	61
800	25000	20	14	7	2	2	62
800	30000	20	14	7	2	2	63
800	35000	20	14	7	2	2	64
800	40000	20	14	7	2	2	65
900	5000	28	15	7	2	2	66
900	10000	23	14	7	2	2	67
900	15000	22	14	7	2	2	68
900	20000	20	13	6	1	1	69
900	25000	19	13	6	1	1	70
900	30000	19	13	6	1	1	71
900	35000	19	13	6	1	1	72
900	40000	19	13	6	1	1	73
1000	5000	28	15	7	2	2	74
1000	10000	23	14	7	2	2	75
1000	15000	22	14	7	2	2	76
1000	20000	20	13	6	1	1	77
1000	25000	19	13	6	1	1	78
1000	30000	19	13	6	1	1	79
1000	35000	19	13	6	1	1	80
1000	40000	19	13	6	1	1	81

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TABLE A-1b.
COST-EFFECTIVENESS
ESTIMATES FOR THE
COMBINATION CHAMBER
SIZE AND EO USE EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	AVERAGE COST EFFECTIVENESS (\$/Mg EO)	INCREMENTAL COST EFFECTIVENESS (\$/Mg EO)	CONTROL OPTION NUMBER
0	0	3776		1
100	5000	3262	165557	2
100	10000	3262	0	3
100	15000	3262	0	4
100	20000	3262	0	5
100	25000	3262	0	6
100	30000	3262	0	7
100	35000	3262	0	8
100	40000	3262	0	9
200	5000	3095	105679	10
200	10000	3088	8917	11
200	15000	3088	0	12
200	20000	3088	0	13
200	25000	3088	0	14
200	30000	3088	0	15
200	35000	3088	0	16
200	40000	3088	0	17
300	5000	2924	81941	18
300	10000	2888	9041	19
300	15000	2878	6627	20
300	20000	2878	0	21
300	25000	2878	0	22
300	30000	2878	0	23
300	35000	2878	0	24
300	40000	2878	0	25
400	5000	2904	76365	26
400	10000	2845	8810	27
400	15000	2839	4507	28
400	20000	2839	0	29
400	25000	2839	0	30
400	30000	2839	0	31
400	35000	2839	0	32
400	40000	2839	0	33
500	5000	2819	69389	34
500	10000	2731	9702	35
500	15000	2715	5050	36
500	20000	2715	0	37
500	25000	2715	0	38
500	30000	2715	0	39
500	35000	2715	0	40
500	40000	2715	0	41
600	5000	2704	59184	42
600	10000	2585	9464	43
600	15000	2557	4922	44
600	20000	2552	3684	45

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TABLE A-1b. (continued)
COST-EFFECTIVENESS
ESTIMATES FOR THE
COMBINATION CHAMBER
SIZE AND EO USE EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	AVERAGE COST EFFECTIVENESS (\$/Mg EO)	INCREMENTAL COST EFFECTIVENESS (\$/Mg EO)	CONTROL OPTION NUMBER
600	25000	2552	0	46
600	30000	2552	0	47
600	35000	2552	0	48
600	40000	2552	0	49
700	5000	2652	54907	50
700	10000	2487	9773	51
700	15000	2437	5118	52
700	20000	2410	5406	53
700	25000	2399	4415	54
700	30000	2399	0	55
700	35000	2399	0	56
700	40000	2399	0	57
800	5000	2610	52947	58
800	10000	2450	9516	59
800	15000	2393	5438	60
800	20000	2366	5406	61
800	25000	2354	4415	62
800	30000	2354	0	63
800	35000	2354	0	64
800	40000	2354	0	65
900	5000	2610	52947	66
900	10000	2430	9758	67
900	15000	2364	5347	68
900	20000	2329	4869	69
900	25000	2317	4415	70
900	30000	2317	0	71
900	35000	2317	0	72
900	40000	2317	0	73
1000	5000	2610	52947	74
1000	10000	2430	9758	75
1000	15000	2364	5347	76
1000	20000	2329	4869	77
1000	25000	2317	4415	78
1000	30000	2317	0	79
1000	35000	2317	0	80
1000	40000	2307	3345	81

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TABLE A-1c.

POPULATION EXPOSED
TO RESIDUAL RISKS
FOR THE COMBINATION
EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	ED USE CUTOFF (lb/yr)	POPULATION EXPOSED TO RISK $\geq 10(-2)$	POPULATION EXPOSED TO RISK $\geq 10(-3)$	POPULATION EXPOSED TO RISK $\geq 10(-4)$	POPULATION EXPOSED TO RISK $\geq 10(-5)$	POPULATION EXPOSED TO RISK $\geq 10(-6)$	CONTROL OPTION NUMBER
0	0	0	0	1703	86795	1686902	1
100	5000	0	0	1755	89421	1731233	2
100	10000	0	0	1755	89421	1731233	3
100	15000	0	0	1755	89421	1731233	4
100	20000	0	0	1755	89421	1731233	5
100	25000	0	0	1755	89421	1731233	6
100	30000	0	0	1755	89421	1731233	7
100	35000	0	0	1755	89421	1731233	8
100	40000	0	0	1755	89421	1731233	9
200	5000	0	0	1931	95313	1808956	10
200	10000	0	0	1931	95313	1874173	11
200	15000	0	0	1931	95313	1874173	12
200	20000	0	0	1931	95313	1874173	13
200	25000	0	0	1931	95313	1874173	14
200	30000	0	0	1931	95313	1874173	15
200	35000	0	0	1931	95313	1874173	16
200	40000	0	0	1931	95313	1874173	17
300	5000	0	0	1979	99266	1897990	18
300	10000	0	0	2234	104573	2057169	19
300	15000	0	0	2249	105212	2062827	20
300	20000	0	0	2249	105212	2062827	21
300	25000	0	0	2249	105212	2062827	22
300	30000	0	0	2249	105212	2062827	23
300	35000	0	0	2249	105212	2062827	24
300	40000	0	0	2249	105212	2062827	25
400	5000	0	0	1979	99304	1902407	26
400	10000	0	0	2319	108132	2127801	27
400	15000	0	0	2374	109459	2166115	28
400	20000	0	0	2374	109459	2166115	29
400	25000	0	0	2374	109459	2166115	30
400	30000	0	0	2374	109459	2166115	31
400	35000	0	0	2374	109459	2166115	32
400	40000	0	0	2374	109459	2166115	33
500	5000	0	0	1993	99843	1925901	34
500	10000	0	0	2915	114728	2230358	35
500	15000	0	0	3233	118254	2340403	36
500	20000	0	0	3233	118254	2340403	37
500	25000	0	0	3233	118254	2340403	38
500	30000	0	0	3233	118254	2340403	39
500	35000	0	0	3233	118254	2340403	40
500	40000	0	0	3233	118254	2340403	41
600	5000	0	0	2064	107419	2106470	42
600	10000	0	0	3583	134906	2552847	43
600	15000	0	0	4241	141458	2807545	44
600	20000	0	0	4337	143808	2896904	45

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TABLE A-1c. (continued)
POPULATION EXPOSED
TO RESIDUAL RISKS
FOR THE COMBINATION
EXEMPTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	ED USE CUTOFF (lb/yr)	POPULATION EXPOSED TO RISK >=10(-2)	POPULATION EXPOSED TO RISK >=10(-3)	POPULATION EXPOSED TO RISK >=10(-4)	POPULATION EXPOSED TO RISK >=10(-5)	POPULATION EXPOSED TO RISK >=10(-6)	CONTROL OPTION NUMBER
600	25000	0	0	4337	143808	2896904	46
600	30000	0	0	4337	143808	2896904	47
600	35000	0	0	4337	143808	2896904	48
600	40000	0	0	4337	143808	2896904	49
700	5000	0	0	2075	110428	2159480	50
700	10000	0	0	3815	146030	2710593	51
700	15000	0	0	4976	173177	3168858	52
700	20000	0	0	5465	179866	3272241	53
700	25000	0	1	5527	188554	3331279	54
700	30000	0	1	5527	188554	3331279	55
700	35000	0	1	5527	188554	3331279	56
700	40000	0	1	5527	188554	3331279	57
800	5000	0	0	2156	112967	2210518	58
800	10000	0	0	3896	148569	2761631	59
800	15000	0	0	5057	175716	3219896	60
800	20000	0	0	5546	182405	3323279	61
800	25000	0	1	5608	191093	3382317	62
800	30000	0	1	5608	191093	3382317	63
800	35000	0	1	5608	191093	3382317	64
800	40000	0	1	5608	191093	3382317	65
900	5000	0	0	2156	112967	2210518	66
900	10000	0	0	4179	150644	2827441	67
900	15000	0	0	5340	181464	3330123	68
900	20000	0	0	5829	188153	3433608	69
900	25000	0	1	5891	196841	3492646	70
900	30000	0	1	5891	196841	3492646	71
900	35000	0	1	5891	196841	3492646	72
900	40000	0	1	5891	196841	3492646	73
1000	5000	0	0	2156	112967	2210518	74
1000	10000	0	0	4179	150644	2827441	75
1000	15000	0	0	5340	181464	3330123	76
1000	20000	0	0	5829	188153	3433608	77
1000	25000	0	1	5891	196841	3492646	78
1000	30000	0	1	5891	196841	3492646	79
1000	35000	0	1	5891	196841	3492646	80
1000	40000	0	1	6362	207327	3600048	81

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TABLE A-2.

ANNUALIZED COST
DATA RANKED ON
INCIDENCE REDUCTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/vr)	INCIDENCE REDUCTION (cases/vr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	REGULATORY OPTION NUMBER
1000	40000	2.5993	90.88	3.66	81
900	25000	2.6125	91.34	3.71	70
1000	25000	2.6125	91.34	3.71	78
900	30000	2.6125	91.34	3.71	71
1000	30000	2.6125	91.34	3.71	79
1000	35000	2.6125	91.34	3.71	80
900	35000	2.6125	91.34	3.71	72
900	40000	2.6125	91.34	3.71	73
900	20000	2.6170	91.49	3.75	69
1000	20000	2.6170	91.49	3.75	77
800	25000	2.6236	91.72	3.81	62
800	30000	2.6236	91.72	3.81	63
800	35000	2.6236	91.72	3.81	64
800	40000	2.6236	91.72	3.81	65
800	20000	2.6281	91.88	3.85	61
1000	15000	2.6317	92.01	3.86	76
900	15000	2.6317	92.01	3.86	68
700	25000	2.6347	92.11	3.89	54
700	30000	2.6347	92.11	3.89	55
700	35000	2.6347	92.11	3.89	56
700	40000	2.6347	92.11	3.89	57
700	20000	2.6392	92.27	3.93	53
800	15000	2.6428	92.40	3.93	60
700	15000	2.6539	92.78	4.01	52
1000	10000	2.6814	93.75	4.06	75
900	10000	2.6814	93.75	4.06	67
800	10000	2.6866	93.93	4.10	59
600	20000	2.6866	93.93	4.24	45
600	25000	2.6866	93.93	4.24	46
600	30000	2.6866	93.93	4.24	47
600	35000	2.6866	93.93	4.24	48
600	40000	2.6866	93.93	4.24	49
600	15000	2.6970	94.29	4.27	44
700	10000	2.6977	94.32	4.17	51
600	10000	2.7204	95.11	4.37	43
500	15000	2.7560	96.35	4.60	36
500	20000	2.7560	96.35	4.60	37
500	25000	2.7560	96.35	4.60	38
500	30000	2.7560	96.35	4.60	39
500	35000	2.7560	96.35	4.60	40
500	40000	2.7560	96.35	4.60	41
500	10000	2.7667	96.73	4.66	35
1000	5000	2.7729	96.94	4.47	74
800	5000	2.7729	96.94	4.47	58
900	5000	2.7729	96.94	4.47	66
400	15000	2.7749	97.01	4.85	28

TABLE A-2. (continued)

ANNUALIZED COST
DATA RANKED ON
INCIDENCE REDUCTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	REGULATORY OPTION NUMBER
400	20000	2.7749	97.01	4.85	29
400	25000	2.7749	97.01	4.85	30
400	30000	2.7749	97.01	4.85	31
400	35000	2.7749	97.01	4.85	32
400	40000	2.7749	97.01	4.85	33
400	10000	2.7807	97.22	4.88	27
700	5000	2.7840	97.33	4.55	50
600	5000	2.7914	97.59	4.65	42
300	15000	2.7924	97.63	4.95	20
300	20000	2.7924	97.63	4.95	21
300	25000	2.7924	97.63	4.95	22
300	30000	2.7924	97.63	4.95	23
300	35000	2.7924	97.63	4.95	24
300	40000	2.7924	97.63	4.95	25
300	10000	2.7947	97.71	4.98	19
500	5000	2.8116	98.30	4.87	34
400	5000	2.8163	98.46	5.03	26
300	5000	2.8184	98.54	5.07	18
200	10000	2.8292	98.91	5.37	11
200	15000	2.8292	98.91	5.37	12
200	20000	2.8292	98.91	5.37	13
200	25000	2.8292	98.91	5.37	14
200	30000	2.8292	98.91	5.37	15
200	35000	2.8292	98.91	5.37	16
200	40000	2.8292	98.91	5.37	17
200	5000	2.8369	99.18	5.39	10
100	5000	2.8510	99.67	5.70	2
100	10000	2.8510	99.67	5.70	3
100	15000	2.8510	99.67	5.70	4
100	20000	2.8510	99.67	5.70	5
100	25000	2.8510	99.67	5.70	6
100	30000	2.8510	99.67	5.70	7
100	35000	2.8510	99.67	5.70	8
100	40000	2.8510	99.67	5.70	9
0	0	2.8603	100.00	6.62	1

TABLE A-3.
POPULATION AT RISK
DATA RANKED ON
INCIDENCE REDUCTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	INCIDENCE REDUCTION (cases/yr)	PEOPLE AT RISK >=10(-2)	PEOPLE AT RISK >=10(-3)	PEOPLE AT RISK >=10(-4)	PEOPLE >=10(-2) [% baseline]	PEOPLE >=10(-3) [% baseline]	PEOPLE >=10(-4) [% baseline]	REGULATORY OPTION NUMBER
1000	40000	2.5993	0	0	1703	0.00	0.03	5.43	81
1000	25000	2.6125	0	0	1755	0.00	0.03	5.03	78
900	30000	2.6125	0	0	1755	0.00	0.03	5.03	71
900	35000	2.6125	0	0	1755	0.00	0.03	5.03	72
1000	30000	2.6125	0	0	1755	0.00	0.03	5.03	79
1000	35000	2.6125	0	0	1755	0.00	0.03	5.03	80
900	40000	2.6125	0	0	1755	0.00	0.03	5.03	73
900	25000	2.6125	0	0	1755	0.00	0.03	5.03	70
1000	20000	2.6170	0	0	1755	0.00	0.00	4.98	77
900	20000	2.6170	0	0	1931	0.00	0.00	4.98	69
800	25000	2.6236	0	0	1931	0.00	0.03	4.79	62
800	30000	2.6236	0	0	1931	0.00	0.03	4.79	63
800	35000	2.6236	0	0	1931	0.00	0.03	4.79	64
800	40000	2.6236	0	0	1931	0.00	0.03	4.79	65
800	20000	2.6281	0	0	1931	0.00	0.00	4.73	61
900	15000	2.6317	0	0	1931	0.00	0.00	4.56	68
1000	15000	2.6317	0	0	1931	0.00	0.00	4.56	76
700	35000	2.6347	0	0	1979	0.00	0.03	4.72	56
700	25000	2.6347	0	0	2234	0.00	0.03	4.72	54
700	30000	2.6347	0	0	2249	0.00	0.03	4.72	55
700	40000	2.6347	0	0	2249	0.00	0.03	4.72	57
700	20000	2.6392	0	0	2249	0.00	0.00	4.66	53
800	15000	2.6428	0	0	2249	0.00	0.00	4.32	60
700	15000	2.6539	0	0	2249	0.00	0.00	4.25	52
900	10000	2.6814	0	0	2249	0.00	0.00	3.57	67
1000	10000	2.6814	0	0	1979	0.00	0.00	3.57	75
600	35000	2.6866	0	0	2319	0.00	0.00	3.70	48
600	30000	2.6866	0	0	2374	0.00	0.00	3.70	47
600	25000	2.6866	0	0	2374	0.00	0.00	3.70	46
600	40000	2.6866	0	0	2374	0.00	0.00	3.70	49
800	10000	2.6866	0	0	2374	0.00	0.00	3.33	59
600	20000	2.6866	0	0	2374	0.00	0.00	3.70	45
600	15000	2.6970	0	0	2374	0.00	0.00	3.62	44
700	10000	2.6977	0	0	1993	0.00	0.00	3.26	51
600	10000	2.7204	0	0	2915	0.00	0.00	3.06	43
500	40000	2.7560	0	0	3233	0.00	0.00	2.76	41
500	20000	2.7560	0	0	3233	0.00	0.00	2.76	37
500	35000	2.7560	0	0	3233	0.00	0.00	2.76	40
500	30000	2.7560	0	0	3233	0.00	0.00	2.76	39
500	25000	2.7560	0	0	3233	0.00	0.00	2.76	38
500	15000	2.7560	0	0	3233	0.00	0.00	2.76	36
500	10000	2.7667	0	0	2064	0.00	0.00	2.49	35
800	5000	2.7729	0	0	3583	0.00	0.00	1.84	58
1000	5000	2.7729	0	0	4241	0.00	0.00	1.84	74
900	5000	2.7729	0	0	4337	0.00	0.00	1.84	66
400	40000	2.7749	0	0	4337	0.00	0.00	2.03	33

TABLE A-3. (continued)
POPULATION AT RISK
DATA RANKED ON
INCIDENCE REDUCTION

TOTAL CHAMBER SIZE CUTOFF (cubic feet)	ED USE CUTOFF (lb/yr)	INCIDENCE REDUCTION (cases/yr)	PEOPLE AT RISK >=10(-2)	PEOPLE AT RISK >=10(-3)	PEOPLE AT RISK >=10(-4)	PEOPLE >=10(-2) [% baseline]	PEOPLE >=10(-3) [% baseline]	PEOPLE >=10(-4) [% baseline]	REGULATORY OPTION NUMBER
400	20000	2.7749	0	0	4337	0.00	0.00	2.03	29
400	15000	2.7749	0	0	4337	0.00	0.00	2.03	28
400	30000	2.7749	0	0	4337	0.00	0.00	2.03	31
400	25000	2.7749	0	0	2075	0.00	0.00	2.03	30
400	35000	2.7749	0	0	3815	0.00	0.00	2.03	32
400	10000	2.7807	0	0	4976	0.00	0.00	1.98	27
700	5000	2.7840	0	0	5465	0.00	0.00	1.77	50
600	5000	2.7914	0	1	5527	0.00	0.00	1.76	42
300	25000	2.7924	0	1	5527	0.00	0.00	1.92	22
300	15000	2.7924	0	1	5527	0.00	0.00	1.92	20
300	20000	2.7924	0	1	5527	0.00	0.00	1.92	21
300	30000	2.7924	0	0	2156	0.00	0.00	1.92	23
300	35000	2.7924	0	0	3896	0.00	0.00	1.92	24
300	40000	2.7924	0	0	5057	0.00	0.00	1.92	25
300	10000	2.7947	0	0	5546	0.00	0.00	1.91	19
500	5000	2.8116	0	1	5608	0.00	0.00	1.70	34
400	5000	2.8163	0	1	5608	0.00	0.00	1.69	26
300	5000	2.8184	0	1	5608	0.00	0.00	1.69	18
200	20000	2.8292	0	1	5608	0.00	0.00	1.65	13
200	35000	2.8292	0	0	2156	0.00	0.00	1.65	16
200	15000	2.8292	0	0	4179	0.00	0.00	1.65	12
200	10000	2.8292	0	0	5340	0.00	0.00	1.65	11
200	25000	2.8292	0	0	5829	0.00	0.00	1.65	14
200	30000	2.8292	0	1	5891	0.00	0.00	1.65	15
200	40000	2.8292	0	1	5891	0.00	0.00	1.65	17
200	5000	2.8369	0	1	5891	0.00	0.00	1.65	10
100	5000	2.8510	0	1	5891	0.00	0.00	1.50	2
100	20000	2.8510	0	0	2156	0.00	0.00	1.50	5
100	40000	2.8510	0	0	4179	0.00	0.00	1.50	9
100	15000	2.8510	0	0	5340	0.00	0.00	1.50	4
100	30000	2.8510	0	0	5829	0.00	0.00	1.50	7
100	35000	2.8510	0	1	5891	0.00	0.00	1.50	8
100	25000	2.8510	0	1	5891	0.00	0.00	1.50	6
100	10000	2.8510	0	1	5891	0.00	0.00	1.50	3
0	0	2.8603	0	1	6362	0.00	0.00	1.45	1

APPENDIX B.

DATA BASES

TABLE B-1. KEY TO DATA BASE FIELDS

Field name	Description	Units
SIC	Standard Industrial Classification	
SIZE_TOT	Total size of all chambers at an individual facility	ft ³
EO_TOT	Total annual EO use at a facility	lb/yr
BAS_EO_EM	Total annual EO emissions at a facility	lb/yr
MED_REDUCE	Annual EO emission reduction at a facility under NESHAP-control conditions	Mg/yr
CUM_MEO_RE	Cumulative emission reduction for facilities at or below cutoff	Mg/yr
CUT_MEO_RE	Emission reduction potential for cutoff	Mg/yr
PER_EO_RED	Percent of total available emission reduction achieved by cutoff	Percent
BASE_INC	Baseline annual incidence for a facility	case/yr
BASE_RISK	Baseline MIR ($\div 10^{-3}$) for a facility	$\times 10^{-3}$
RED_INC	Annual incidence reduction for a facility under NESHAP-control conditions	case/yr
CUM_IN_RED	Cumulative incidence reduction for facilities at or below cutoff	case/yr
TAC_M	Total annualized costs (in \$1,000) for achieving NESHAP-level control at a facility	$\times \$1,000$
CUM_TAC_MM	Cumulative annualized costs (in \$MM) of controlling facilities at or below cutoff	$\times \$1,000,000$
CUT_TAC_MM	Annualized control costs (in \$MM) for cutoff	$\times \$1,000,000$
CEFF_M	Cost-effectiveness estimate (in \$1,000) for a facility	$\times \$1,000$
LIFE_COST	Cost per case reduced (in \$MM) for an individual facility	$\times \$1,000,000$

TABLE B-2.

B2

SIC	SIZE	EQ_101	BAS_EQ_EN	MED_REDUCE	CUM_MED_RE	PER_EQ_RE	CUT_MED_RE	BASE_INC	RISK3_RED_INC	CUM_IN_RED	PER_IN_RED	CUT_IN_RED	TAC_M_CUM_TAC_MM	PER_TAC_CUT	TAC_MM	DIFF_M	LIFE_COST
2822	2.57	6.00	6.00	0.003	0.003	0.007	100.00	1753.069	0.0000	0.00012	0.0000	100.00	2.8603	21.1	0.0211	99.68	6.5000
2099	2.50	9.00	9.00	0.004	0.004	0.007	100.00	1753.065	0.0000	0.00037	0.0000	100.00	2.8603	21.1	0.0422	99.36	6.5800
7391	3.50	6.00	6.00	0.003	0.003	0.010	100.00	1753.062	0.0000	0.00011	0.0000	100.00	2.8603	21.1	0.0633	99.04	6.5600
2834	5.00	65.00	65.00	0.028	0.028	0.038	100.00	1753.034	0.0000	0.00103	0.0000	100.00	2.8603	21.1	0.0844	98.73	6.5400
2834	7.00	16.80	16.80	0.007	0.007	0.045	100.00	1753.027	0.0001	0.00087	0.0001	100.00	2.8602	21.1	0.1060	98.40	6.5100
3841	8.00	12.00	12.00	0.005	0.005	0.050	100.00	1753.022	0.0001	0.00049	0.0001	99.99	2.8599	21.1	0.1270	98.08	6.4900
2834	8.80	194.00	194.00	0.083	0.125	0.133	99.99	1752.939	0.0002	0.00335	0.0002	99.99	2.8599	21.1	0.1480	97.76	6.4700
2834	9.26	291.60	291.60	0.125	0.175	0.158	99.99	1752.814	0.0004	0.01850	0.0004	99.97	2.8594	21.1	0.1690	97.45	6.4500
3841	9.70	162.00	162.00	0.069	0.104	0.104	99.98	1752.731	0.0000	0.00452	0.0001	99.97	2.8594	21.1	0.1900	97.13	6.4300
8922	12.00	32.40	32.40	0.014	0.014	0.341	99.98	1752.682	0.0000	0.00069	0.0000	99.97	2.8594	21.1	0.2110	96.81	6.4100
2834	12.00	113.00	113.00	0.049	0.049	0.390	99.98	1752.682	0.0000	0.00438	0.0000	99.97	2.8594	21.1	0.2320	96.50	6.3900
3841	12.00	126.00	126.00	0.053	0.053	0.443	99.97	1752.629	0.0001	0.00606	0.0001	99.97	2.8593	21.1	0.2530	96.09	6.3600
2822	14.00	4.80	4.80	0.002	0.002	0.445	99.97	1752.627	0.0000	0.00008	0.0000	99.97	2.8593	21.1	0.2800	95.77	6.3400
8411	18.00	1.50	1.50	0.001	0.001	0.446	99.97	1752.626	0.0000	0.00000	0.0000	99.97	2.8593	21.1	0.3010	95.45	6.3200
8411	18.00	2.00	2.00	0.001	0.001	0.447	99.97	1752.625	0.0000	0.00008	0.0000	99.97	2.8593	21.1	0.3220	95.14	6.3000
8411	18.00	2.98	2.98	0.001	0.001	0.448	99.97	1752.624	0.0000	0.00015	0.0000	99.97	2.8593	21.1	0.3430	94.82	6.2800
8411	18.00	7.50	7.50	0.003	0.003	0.451	99.97	1752.621	0.0000	0.00012	0.0000	99.97	2.8593	21.1	0.3640	94.50	6.2600
8231	18.00	32.40	32.40	0.014	0.014	0.465	99.97	1752.607	0.0001	0.00133	0.0001	99.96	2.8592	21.1	0.3850	94.18	6.2400
3841	25.00	1231.00	1231.00	0.525	0.525	0.493	99.97	1752.579	0.0000	0.00111	0.0000	99.96	2.8592	21.1	0.4060	93.87	6.2100
3841	30.00	324.00	324.00	0.139	0.139	1.157	99.93	1751.915	0.0002	0.01870	0.0002	99.91	2.8577	21.2	0.4490	93.22	6.1700
3841	30.00	875.00	875.00	0.373	0.373	1.530	99.91	1751.542	0.0003	0.12200	0.0003	99.90	2.8574	21.4	0.4700	92.90	6.1500
3841	32.00	93.60	93.60	0.040	0.040	1.570	99.91	1751.502	0.0000	0.00294	0.0000	99.90	2.8574	21.4	0.4910	92.58	6.1300
3841	35.85	64.10	64.10	0.028	0.028	1.598	99.91	1751.474	0.0001	0.00294	0.0001	99.90	2.8573	21.4	0.5180	92.18	6.1000
8411	36.00	6.00	6.00	0.003	0.003	1.601	99.91	1751.471	0.0000	0.00022	0.0000	99.90	2.8573	21.1	0.5390	91.86	6.0800
8411	36.00	100.80	100.80	0.043	0.043	1.644	99.91	1751.428	0.0001	0.00253	0.0001	99.89	2.8572	21.1	0.5600	91.54	6.0600
2834	39.10	194.00	194.00	0.830	0.830	2.474	99.86	1750.598	0.0018	0.05240	0.0017	99.83	2.8553	23.5	0.5840	91.18	6.0400
2834	42.29	185.25	185.25	0.079	0.079	2.553	99.85	1750.519	0.0002	0.00457	0.0002	99.83	2.8553	22.7	0.6070	90.83	6.0100
2834	50.00	456.00	456.00	0.194	0.194	2.747	99.84	1750.325	0.0003	0.00850	0.0003	99.81	2.8550	69.1	0.6670	89.92	5.9500
3841	70.00	188.00	188.00	0.080	0.080	2.827	99.84	1750.245	0.0001	0.00396	0.0001	99.81	2.8549	22.7	0.6900	89.58	5.9300
3841	70.00	200.00	200.00	0.085	0.085	2.912	99.83	1750.160	0.0002	0.01260	0.0002	99.80	2.8547	23.9	0.7140	89.21	5.9100
279	70.00	312.00	312.00	0.133	0.133	3.045	99.83	1750.027	0.0001	0.01270	0.0001	99.80	2.8546	23.9	0.7380	88.85	5.8800
279	70.00	312.00	312.00	0.133	0.133	3.178	99.82	1749.894	0.0001	0.00716	0.0001	99.80	2.8545	23.9	0.7620	88.49	5.8600
2834	70.80	1092.00	1092.00	0.466	0.466	3.644	99.79	1749.428	0.0002	0.00033	0.0002	99.79	2.8543	21.5	0.7840	88.16	5.8400
8411	75.00	1980.00	1980.00	0.844	0.844	4.488	99.74	1748.584	0.0011	0.14100	0.0010	99.76	2.8533	21.9	0.8060	87.82	5.8100
8411	75.49	32.40	32.40	0.014	0.014	4.502	99.74	1748.570	0.0000	0.00173	0.0000	99.76	2.8533	21.1	0.8270	87.51	5.7900
8922	77.80	201.60	201.60	0.086	0.086	4.588	99.74	1748.484	0.0001	0.01100	0.0001	99.75	2.8532	44.1	0.8710	86.84	5.7500
3841	81.80	2254.00	2254.00	0.961	0.961	5.549	99.68	1747.523	0.0023	0.06410	0.0022	99.67	2.8510	25.0	0.8960	86.47	5.7200
8411	98.00	17.80	17.80	0.008	0.008	5.557	99.68	1747.515	0.0000	0.00077	0.0000	99.67	2.8510	21.1	0.9170	86.15	5.7000
2834	100.00	70.00	70.00	0.030	0.030	5.587	99.68	1747.485	0.0001	0.00344	0.0001	99.67	2.8509	21.1	0.9380	85.83	5.6800
2834	103.00	388.80	388.80	0.166	0.166	5.753	99.67	1747.319	0.0006	0.00961	0.0006	99.65	2.8503	21.2	0.9590	85.51	5.6600
8411	105.00	6.00	6.00	0.003	0.003	5.756	99.67	1747.316	0.0000	0.00033	0.0000	99.65	2.8503	21.1	0.9800	85.20	5.6400
2834	105.00	557.30	557.30	0.238	0.238	5.994	99.66	1747.078	0.0003	0.06780	0.0003	99.64	2.8500	21.3	1.0000	84.89	5.6200
2834	116.00	581.00	581.00	0.247	0.247	6.241	99.64	1746.831	0.0002	0.03830	0.0002	99.63	2.8498	22.9	1.0200	84.59	5.6000
2834	126.00	192.00	192.00	0.082	0.082	6.323	99.64	1746.749	0.0000	0.00401	0.0000	99.63	2.8498	21.1	1.0400	84.29	5.5800
2834	126.00	530.25	530.25	0.212	0.212	6.535	99.63	1746.537	0.0012	0.02710	0.0011	99.59	2.8487	1.0	1.0600	84.29	5.5800
7391	129.00	562.00	562.00	0.240	0.240	6.775	99.61	1746.297	0.0000	0.01940	0.0000	99.59	2.8487	21.1	1.0800	83.98	5.5200
3841	138.80	3135.00	3135.00	1.337	1.337	8.112	99.53	1744.960	0.0100	0.10000	0.0094	99.26	2.8391	24.9	1.1000	83.68	5.5000
2834	158.00	296.25	296.25	0.123	0.123	8.235	99.53	1744.837	0.0002	0.01310	0.0002	99.26	2.8391	24.9	1.1200	83.38	5.4800
3841	160.00	520.00	520.00	0.222	0.222	8.457	99.52	1744.615	0.0003	0.01530	0.0003	99.25	2.8388	21.3	1.1400	82.78	5.4600
3841	168.00	5258.00	5258.00	2.243	2.243	10.700	99.39	1742.372	0.0082	0.00423	0.0077	98.98	2.8311	24.9	1.1600	82.18	5.4400
2834	181.50	2599.20	2599.20	1.109	1.109	11.802	99.33	1741.263	0.0005	0.04900	0.0005	98.96	2.8306	26.7	1.1800	81.72	5.4100
3841	194.00	4860.00	4860.00	2.073	2.073	13.882	99.21	1739.190	0.0015	0.29700	0.0014	98.91	2.8292	23.2	1.2000	81.42	5.3900
2834	204.00	504.00	504.00	0.215	0.215	14.097	99.20	1738.975	0.0009	0.02030	0.0008	98.88	2.8284	21.3	1.2200	81.12	5.3700
3841	204.55	10613.00	10613.00	4.527	4.527	18.624	98.94	1734.448	0.0025	0.44400	0.0023	98.80	2.8261	25.6	1.2400	80.66	5.3400

TABLE B-2. (continued)

B4

SIC	SIZE_TOT	ED_TOT	BAS_ED_EN_MED_REDUCE	CUM_MED_RE	PER_ED	CUT_MED_RE	BASE_INC	BASE_RISKS	RED_INC	CUM_IN_RED	PER_IN_RED	CUT_IN_RED	TAC_M	CUM_TAC_MH	PER_TAC	CUT_TAC	TAC_MH	CEFF_M	LIFE_COST
3841	675.00	2016.00	1011.02	0.410	163.332	90.68	1589.740	0.0005	0.03390	0.0004	0.2947	89.70	2.5656	1.3	2.7600	58.31	3.8600	3.200	3.300
3841	698.00	7387.00	7387.00	3.151	166.483	90.50	1584.589	0.0012	0.40400	0.0011	0.2958	89.66	2.5645	25.2	2.7900	57.85	3.8300	8.000	23.000
2099	750.00	2527.00	2527.00	1.078	167.561	90.44	1585.511	0.0041	0.06200	0.0038	0.2996	89.53	2.5607	35.6	2.8300	57.25	3.7900	33.000	9.400
3841	770.50	4286.90	4286.90	1.829	169.390	90.34	1583.682	0.0078	0.19400	0.0073	0.3069	89.27	2.5534	37.8	2.8700	56.65	3.7500	21.000	5.200
2834	800.00	14400.00	14400.00	6.143	175.533	89.99	1577.539	0.0063	0.09580	0.0059	0.3128	89.06	2.5475	28.8	2.9000	56.19	3.7200	4.700	4.900
3841	810.00	7550.00	7550.00	3.135	178.668	89.81	1574.404	0.0055	0.24000	0.0052	0.3180	88.88	2.5423	40.4	2.9400	55.59	3.6800	13.000	7.800
3841	852.00	18268.00	18268.00	7.793	186.461	89.36	1566.611	0.0000	0.00114	0.0000	0.3180	88.88	2.5423	37.3	2.9800	54.98	3.6400	4.800	*****
7391	975.00	35040.00	35040.00	14.948	201.409	88.51	1551.663	0.0140	0.91300	0.0132	0.3312	88.42	2.5291	46.0	3.0300	54.23	3.5900	3.100	3.500
2099	1000.00	1155.00	1155.00	0.493	201.902	88.48	1551.170	0.0089	0.03000	0.0083	0.3395	88.13	2.5208	38.5	3.0700	53.63	3.5500	78.000	4.600
3841	1000.00	5016.00	5016.00	2.139	204.041	88.36	1549.031	0.0073	0.22400	0.0069	0.3464	87.89	2.5139	39.7	3.1100	53.02	3.5100	19.000	5.800
7399	1000.00	8736.00	8736.00	3.726	207.767	88.15	1545.305	0.0170	0.50200	0.0161	0.3625	87.33	2.4978	40.8	3.1500	52.42	3.4700	11.000	2.500
3841	1000.00	14860.00	14860.00	6.339	214.106	87.79	1538.966	0.0093	0.57800	0.0087	0.3712	87.02	2.4891	42.7	3.1900	51.81	3.4300	4.900	4.900
2099	1000.00	40800.00	40800.00	17.405	231.511	86.79	1521.561	0.0240	1.99600	0.0225	0.3937	86.74	2.4666	50.5	3.2400	51.06	3.3800	2.900	2.200
7399	1009.61	12020.00	12020.00	5.128	236.639	86.50	1516.433	0.0048	0.97200	0.0045	0.3982	86.08	2.4621	69.5	3.3100	50.00	3.3100	14.000	15.000
3841	1044.00	15040.00	15040.00	3.585	240.224	86.30	1512.848	0.0009	0.78300	0.0008	0.3990	86.05	2.4613	37.8	3.3500	49.40	3.2700	11.000	47.000
3841	1045.00	18653.00	18653.00	7.958	248.182	85.84	1504.890	0.0066	1.34000	0.0062	0.4052	85.83	2.4551	42.3	3.3900	48.79	3.2300	5.300	6.800
2099	1066.00	804.00	804.00	0.343	248.525	85.82	1504.547	0.0010	0.03980	0.0009	0.4061	85.80	2.4542	38.4	3.4300	48.19	3.1900	110.000	43.000
3841	1100.00	24120.00	24120.00	10.290	258.815	85.24	1494.257	0.0057	1.15000	0.0053	0.4116	85.62	2.4477	44.7	3.4800	47.43	3.1400	4.400	8.500
3841	1102.00	21911.00	21911.00	9.348	268.163	84.70	1484.709	0.0280	1.22000	0.0262	0.4376	84.70	2.4277	44.7	3.5200	46.83	3.1000	4.800	1.700
7399	1128.00	1800.00	1800.00	0.768	268.931	84.66	1484.141	0.0010	0.07060	0.0009	0.4385	84.67	2.4218	40.3	3.5600	46.22	3.0600	52.000	45.000
2834	1160.00	24082.00	24082.00	5.904	274.835	84.32	1478.237	0.0270	0.91900	0.0244	0.4629	83.82	2.3974	42.4	3.6000	45.62	3.0200	7.200	1.700
2099	1238.00	2419.20	2419.20	1.032	275.867	84.26	1477.205	0.0093	0.06970	0.0087	0.4716	83.51	2.3887	38.9	3.6400	45.02	2.9800	38.000	4.500
2834	1248.00	6451.00	6451.00	2.752	278.619	84.11	1474.453	0.0090	0.01620	0.0085	0.4801	83.22	2.3802	41.8	3.6800	44.41	2.9400	15.000	4.900
2099	1248.00	36000.00	36000.00	15.358	293.977	83.23	1459.095	0.0180	1.63000	0.0170	0.4971	82.62	2.3632	49.4	3.7300	43.66	2.8900	3.200	2.900
3841	1266.00	22560.00	22560.00	9.624	303.601	82.48	1449.471	0.0032	0.43400	0.0030	0.5001	82.52	2.3602	48.1	3.7800	42.90	2.8400	5.000	16.000
3841	1300.00	108000.00	108000.00	4.863	308.464	82.60	1444.608	0.0095	0.38900	0.0089	0.5090	82.20	2.3513	41.7	3.8200	42.30	2.8000	8.600	4.700
3841	1334.00	11547.00	11547.00	4.926	359.464	79.78	1398.538	0.0041	1.16000	0.0036	0.5126	81.53	2.3377	65.2	3.8900	41.24	2.7300	1.400	18.000
3841	1358.00	11547.00	11547.00	4.926	359.464	79.50	1393.608	0.0160	0.38900	0.0150	0.5276	81.53	2.3377	44.8	3.9300	40.63	2.6900	9.100	3.000
3841	1475.00	21135.00	21135.00	9.016	368.480	78.98	1384.592	0.0260	0.84800	0.0242	0.5318	80.71	2.3085	44.5	3.9700	40.03	2.6500	4.900	1.800
2834	1545.00	24000.00	24000.00	10.239	378.719	78.40	1374.353	0.0025	1.37000	0.0024	0.5542	80.62	2.3041	32.3	4.0000	39.58	2.6200	3.200	13.000
7399	1575.00	93450.00	93450.00	39.866	378.515	76.12	1334.487	0.0950	3.06000	0.0876	0.6438	77.49	2.2165	62.3	4.0600	38.67	2.5600	1.600	0.700
3841	1606.00	126208.00	126208.00	25.504	448.089	74.67	1308.983	0.2100	6.85000	0.1870	0.8308	70.92	2.0285	12.7	4.3700	38.52	2.5500	0.500	0.068
7399	1675.00	13000.00	13000.00	5.546	449.635	74.35	1303.437	0.0011	0.72200	0.0010	0.8318	70.92	2.0285	43.8	4.1100	37.92	2.5100	7.900	44.000
2099	1745.00	5850.00	5850.00	2.496	452.131	74.21	1300.941	0.0000	0.00009	0.0000	0.8318	70.92	2.0285	57.6	4.1700	37.01	2.4500	23.000	*****
7399	1751.00	41320.00	41320.00	17.627	469.758	73.20	1283.314	0.0210	0.10000	0.0197	0.8515	70.23	2.0088	35.3	4.2300	36.10	2.3900	3.100	2.800
3841	1874.90	16426.00	16426.00	7.007	476.763	72.80	1276.307	0.0300	0.71000	0.0283	0.8798	69.24	1.9805	44.8	4.2700	35.50	2.3500	6.400	1.600
2834	1904.00	11016.00	11016.00	4.700	481.465	72.54	1271.607	0.0160	0.56000	0.0151	0.8949	68.71	1.9654	34.7	4.3000	35.05	2.3200	7.400	2.300
2834	1907.70	23954.00	23954.00	10.219	491.684	71.95	1261.388	0.0087	0.38800	0.0081	0.9030	68.43	1.9573	51.1	4.3500	34.29	2.2700	5.000	6.300
3841	1915.00	39105.00	39105.00	16.682	508.366	71.00	1248.706	0.0540	0.87900	0.0508	0.9538	66.63	1.9065	52.8	4.4000	33.53	2.2200	3.200	1.000
2834	1974.00	18057.00	18057.00	7.703	516.069	70.56	1237.061	0.0120	0.77900	0.0113	0.9651	66.26	1.8952	46.8	4.4500	32.78	2.1700	6.100	4.100
3841	1998.00	16956.00	16956.00	7.234	523.303	70.15	1229.769	0.0048	0.50100	0.0045	0.9696	66.10	1.8907	46.5	4.5000	32.02	2.1200	10.000	10.000
7399	2000.00	15724.00	15724.00	6.708	530.011	69.77	1223.061	0.0024	0.09533	0.0023	0.9719	66.02	1.8884	44.6	4.5400	31.42	2.0800	6.600	19.000
3841	2000.00	60747.00	60747.00	19.920	549.931	68.63	1223.061	0.0390	1.15000	0.0360	1.0079	64.76	1.8381	59.7	4.5900	30.66	2.0300	2.500	1.400
3841	2004.00	84030.00	84030.00	25.915	575.846	67.15	1177.226	0.0160	3.12000	0.0143	1.0222	64.26	1.8381	59.7	4.6400	29.76	1.9700	2.200	4.100
2099	2080.00	130000.00	130000.00	26.509	619.342	64.67	1133.730	0.0350	5.73000	0.0315	1.0581	63.08	1.8042	12.9	4.6700	29.46	1.9500	0.490	0.410
7399	2365.00	66503.00	66503.00	16.304	635.646	63.74	1117.426	0.0027	1.96000	0.0024	1.0222	64.26	1.8381	59.7	4.6400	29.76	1.9700	2.200	4.100
2099	2370.00	13000.00	13000.00	5.546	641.192	63.42	1111.880	0.0340	3.12000	0.0315	1.0581	63.08	1.8042	12.9	4.6700	29.46	1.9500	0.490	0.410
7399	2400.00	24000.00	24000.00	10.239	651.431	62.84	1101.641	0.0180	0.69400	0.0170	1.1756	58.90	1.6677	45.2	4.7900	27.64	1.8300	12.000	2.000
2834	2444.00	8390.00	8390.00	3.579	655.010	62.64	1098.062	0.0026	0.26500	0.0023	1.1949	58.22	1.6654	42.3	4.8800	26.28	1.7400	12.000	2.000
3841	2534.00	26549.00	26549.00	11.326	666.336	61.99	1086.736	0.0023	0.78500	0.0021	1.1970	58.15	1.6633	53.4	4.9300	25.53	1.6900	4.700	25.000
3841	2574.00	121888.00	121888.00	51.999	718.335	59.02	1034.737	0.1500	5.30000	0.1410	1.3380	53.22	1.5223	73.4	5.0000	23.47	1.6200	1.400	0.520
3841	2668.00	132000.00	132000.00	56.312	774.647	53.81	978.425	0.0880	6.78000	0.0800	1.4880	50.42	1.4423	75.6	5.0800	23.26	1.5400	1.300	0.950
2834	2710.00	176000.00	88244.00	35.817	810.464	53.77	942.608	0.0290	9.45000	0.0263	1.4443	49.51	1.4160	1.0	5.0800	23.26	1.5400	1.300	0.950
2834	2828.00	82720.00	41773.60	16.716	827.180	52.82	925.892	0.0310	2.84000	0.0278	1.4721								

TABLE B-2. (continued)

SIC	SIZE TOT	EQ TOT	BAS_ED_EN_MED_REDUCE	CUM_MED_RE	PER_ED_CUT	MED_RE	BASE_INC	RISKS3	RED_INC	CUM_IN_RED	PER_IN_RED	CUT_IN_RED	TAC_M_CUM	TAC_MH	PER_TAC_CUT	TAC_MH	CEFF_M	LIFE_COST
3841	2980.00	36192.00	18186.49	7.351	834.531	52.40	918.541	0.0054	0.54100	0.0049	1.4770	48.36	1.5833	9.5	5.1000	22.96	1.300	1,900
3841	3001.00	78006.00	33.278	867.809	50.50	885.263	0.0420	2.56000	0.0383	1.5153	47.02	1.3450	5.1800	21.75	1.4400	2.300	2,000	
3841	3024.00	42009.00	17.921	885.730	49.48	867.342	0.0180	2.48000	0.0170	1.5323	46.43	1.3280	5.2500	20.69	1.3700	3.600	3,800	
2822	3180.00	57600.00	24.573	910.303	48.07	842.769	0.0700	2.55000	0.0659	1.5982	44.12	1.2621	5.3200	19.64	1.3000	2.900	1,100	
2834	3206.00	147000.00	62.712	973.015	44.50	780.057	0.0990	10.50000	0.0937	1.6919	40.85	1.1684	5.4000	18.43	1.2200	1.200	0,800	
2834	3359.00	94474.00	26.008	999.023	43.01	754.049	0.0130	4.70000	0.0119	1.7038	40.43	1.1565	5.4800	17.22	1.1400	3.000	6,600	
2834	3600.77	68941.00	14.161	1013.184	42.21	739.888	0.0017	1.69000	0.0015	1.7053	40.38	1.1550	5.4900	17.07	1.1300	0.660	6,200	
3841	3606.00	61710.00	14.709	1027.893	41.37	725.179	0.0023	1.88000	0.0021	1.7074	40.31	1.1529	5.6700	16.01	1.0600	4.600	32,000	
3841	3950.00	92600.00	39.504	1067.397	39.11	685.675	0.0260	2.43000	0.0244	1.7318	39.45	1.1285	5.7300	15.11	1.0000	1.500	2,300	
2099	3955.00	29700.00	6.002	1073.399	38.77	679.673	0.0095	0.94700	0.0084	1.7402	39.16	1.1201	5.7400	14.95	0.9900	1.300	0,920	
3841	4000.00	37040.00	6.533	1079.932	38.40	673.140	0.0061	0.79900	0.0055	1.7457	38.97	1.1146	5.8400	14.80	0.9800	1.200	1,500	
3841	4002.00	149000.00	63.585	1143.497	34.77	609.575	0.0049	0.05800	0.0046	1.7503	38.81	1.1100	5.7500	13.29	0.8700	0.940	5,200	
3841	4075.00	29500.00	6.162	1149.459	34.42	603.413	0.0020	0.83400	0.0018	1.7521	38.74	1.1082	5.8	12.08	0.8000	1.500	21,000	
3841	4200.00	86950.00	19.770	1169.429	33.29	583.643	0.0300	1.96000	0.0270	1.7791	37.80	1.0812	70.4	5.8200	12.08	3.600	2,600	
7399	4235.00	134680.00	57.456	1226.885	30.02	526.187	0.4000	6.62000	0.3760	2.1551	24.65	0.7052	81.9	5.9000	10.88	1.400	0,220	
7399	4681.00	137778.00	58.777	1285.662	26.66	467.410	0.1300	5.39000	0.1223	2.2774	20.38	0.5829	84.2	5.9800	9.67	1.400	0,690	
7399	4696.00	43050.00	18.365	1304.027	25.61	449.045	0.0390	0.75400	0.0358	2.3132	19.13	0.5471	79.3	6.0600	8.46	4.300	2,200	
7399	4725.00	237300.00	82.945	1386.972	20.88	366.100	0.1100	9.71000	0.1020	2.4152	15.56	0.4451	105.0	6.1700	6.80	1.300	1,000	
3841	5006.00	160030.00	68.270	1453.242	16.99	297.830	0.0066	6.25000	0.0062	2.4214	15.34	0.4389	99.3	6.2700	5.29	1.500	16,000	
3841	5202.00	149200.00	63.650	1518.892	13.36	234.180	0.0210	8.43000	0.0195	2.4409	14.66	0.4194	98.6	6.3700	3.78	1.500	5,100	
3841	6000.70	240030.00	102.399	1621.291	7.52	131.781	0.0140	0.04340	0.0131	2.4540	14.20	0.4063	117.0	6.4900	1.96	1.000	8,900	
3841	7318.00	41760.00	8.533	1679.824	7.03	123.248	0.0012	1.10000	0.0011	2.4551	14.17	0.4052	9.6	6.5000	1.81	1.100	8,700	
3841	7434.00	110614.00	47.189	1677.013	4.34	76.059	0.0250	2.98000	0.0235	2.4786	13.34	0.3817	89.2	6.5900	0.45	1.900	3,800	
2834	8120.00	215697.00	108882.85	43.568	1720.581	1.85	32.491	0.2700	7.78000	0.2390	2.7176	4.99	0.1427	0.45	0.0300	0.092	0,017	
3841	9598.40	101976.00	51497.92	20.608	1741.189	0.68	11.883	0.0720	2.97000	0.0647	2.7823	2.73	0.0780	0.15	0.0100	0.810	0,260	
7399	9800.00	58800.00	29694.00	11.883	1753.072	0.00	0.000	0.0880	1.51000	0.0780	2.8603	0.00	0.0000	8.0	6.6200	0.00	0,100	

TABLE B-3.

11/03/87 POPSIZE.dbf

SIC	SIZE TOT	EO TOT	BAS ED EM	BASEPOP2	BASEPOP3	BASEPOP4	BASEPOP5	BASEPOP6	CONPOP2	CONPOP3	CONPOP4	CONPOP5	CONPOP6
2822	0.57	6.00	6.00	0	0	0	0	0	0	0	0	0	0
2099	2.50	9.00	9.00	0	0	0	0	0	0	0	0	0	0
7391	3.50	6.00	6.00	0	0	0	0	0	0	0	0	0	0
2834	5.00	65.00	65.00	0	0	0	0	6	0	0	0	0	0
2834	7.00	16.80	16.80	0	0	0	0	0	0	0	0	0	0
3841	8.00	12.00	12.00	0	0	0	0	0	0	0	0	0	0
2834	8.80	194.00	194.00	0	0	0	0	115	0	0	0	0	0
2834	9.26	291.60	291.60	0	0	0	3	186	0	0	0	0	0
3841	9.70	162.00	162.00	0	0	0	0	178	0	0	0	0	0
3841	12.00	126.00	126.00	0	0	0	0	244	0	0	0	0	0
8922	12.00	32.40	32.40	0	0	0	0	0	0	0	0	0	0
2834	12.00	113.00	113.00	0	0	0	0	0	0	0	0	0	0
2822	14.00	4.80	4.80	0	0	0	0	0	0	0	0	0	0
8231	18.00	64.00	64.00	0	0	0	0	169	0	0	0	0	0
8411	18.00	2.00	2.00	0	0	0	0	0	0	0	0	0	0
8411	18.00	2.98	2.98	0	0	0	0	0	0	0	0	0	0
8411	18.00	7.50	7.50	0	0	0	0	0	0	0	0	0	0
8231	18.00	32.40	32.40	0	0	0	0	88	0	0	0	0	0
8411	18.00	1.50	1.50	0	0	0	0	0	0	0	0	0	0
3841	25.00	1231.00	1231.00	0	0	0	1178	6832	0	0	0	0	272
3841	30.00	875.00	875.00	0	0	3	43	1232	0	0	0	0	26
3841	30.00	324.00	324.00	0	0	0	0	2	0	0	0	0	0
3841	32.00	93.60	93.60	0	0	0	0	56	0	0	0	0	0
3841	35.85	64.10	64.10	0	0	0	0	190	0	0	0	0	0
8411	36.00	6.00	6.00	0	0	0	0	0	0	0	0	0	0
8411	36.00	100.80	100.80	0	0	0	0	215	0	0	0	0	0
2834	39.10	1944.00	1944.00	0	0	0	183	9241	0	0	0	0	76
2834	42.29	185.25	185.25	0	0	0	0	135	0	0	0	0	0
2834	50.00	456.00	456.00	0	0	0	0	1417	0	0	0	0	0
279	70.00	312.00	312.00	0	0	0	0	188	0	0	0	0	0
3841	70.00	200.00	200.00	0	0	0	5	1642	0	0	0	0	0
3841	70.00	188.00	188.00	0	0	0	0	192	0	0	0	0	0
279	70.00	312.00	312.00	0	0	0	2	76	0	0	0	0	0
2834	70.80	1092.00	1092.00	0	0	0	0	0	0	0	0	0	0
3841	75.00	1980.00	1980.00	0	0	49	537	7788	0	0	0	0	166
8411	75.49	32.40	32.40	0	0	0	0	4	0	0	0	0	0
8922	77.80	201.60	201.60	0	0	0	4	78	0	0	0	0	0
3841	81.80	2254.00	2254.00	0	0	0	671	14858	0	0	0	0	261
8411	98.00	17.80	17.80	0	0	0	0	0	0	0	0	0	0
2834	100.00	70.00	70.00	0	0	0	0	289	0	0	0	0	0
2834	103.00	388.80	388.80	0	0	0	0	4183	0	0	0	0	0
8411	105.00	6.00	6.00	0	0	0	0	0	0	0	0	0	0
2834	105.00	557.30	557.30	0	0	0	28	1899	0	0	0	0	19
2834	116.00	581.00	581.00	0	0	0	0	638	0	0	0	0	0
2834	126.00	192.00	192.00	0	0	0	0	25	0	0	0	0	0
2834	126.00	1050.00	1050.00	0	0	0	152	2409	0	0	0	0	62
7391	129.00	562.00	562.00	0	0	0	0	363	0	0	0	0	0
3841	138.80	3135.00	3135.00	0	0	145	4982	62792	0	0	0	0	3071
2834	158.00	395.00	395.00	0	0	0	3	66	0	0	0	0	0
3841	160.00	520.00	520.00	0	0	0	23	455	0	0	0	0	0
3841	168.00	5258.00	5258.00	0	0	0	0	65217	0	0	0	0	0
2834	181.50	2599.20	2599.20	0	0	0	52	3094	0	0	0	0	26
3841	194.00	4860.00	4860.00	0	0	31	652	4888	0	0	0	0	200
2834	204.00	504.00	504.00	0	0	0	136	3853	0	0	0	0	0
3841	204.55	10613.00	10613.00	0	0	15	641	5911	0	0	0	2	253

TABLE B-3. (continued)

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11/03/87 POPSIZE.dbf

SIC	SIZE	TOT	ED	TOT	BAS	ED	EM	BASEPOP2	BASEPOP3	BASEPOP4	BASEPOP5	BASEPOP6	COMPOP2	COMPOP3	COMPOP4	COMPOP5	COMPOP6
7399	213.00	195.00	195.00	0	0	0	0	0	0	0	0	336	0	0	0	0	0
2099	244.00	6048.00	6048.00	0	0	140	2121	37209	0	0	0	37209	0	0	0	0	912
3841	250.00	3755.00	3755.00	0	0	0	0	125	7224	0	0	7224	0	0	0	0	62
7399	250.00	160.80	160.80	0	0	0	0	0	188	0	0	188	0	0	0	0	0
8411	250.00	64.80	64.80	0	0	0	0	0	21	0	0	21	0	0	0	0	0
2834	260.00	5189.00	5189.00	0	0	106	2391	32482	0	0	0	32482	0	0	0	0	1306
3841	264.00	1714.00	1714.00	0	0	12	306	14034	0	0	0	14034	0	0	0	0	75
2834	267.00	1750.00	1750.00	0	0	0	0	8	3615	0	0	3615	0	0	0	0	2
3841	267.00	6840.00	6840.00	0	0	9	799	26702	0	0	0	26702	0	0	0	4	213
3841	270.00	1750.00	1750.00	0	0	36	724	11507	0	0	0	11507	0	0	0	0	125
2834	270.00	2376.00	2376.00	0	0	0	0	853	26019	0	0	26019	0	0	0	0	718
3841	270.00	432.00	432.00	0	0	0	20	423	0	0	0	423	0	0	0	0	0
279	270.00	390.00	390.00	0	0	0	0	35	0	0	0	35	0	0	0	0	0
279	280.00	110.00	110.00	0	0	0	0	26	0	0	0	26	0	0	0	0	0
3841	280.00	2142.00	2142.00	0	0	0	1168	17132	0	0	0	17132	0	0	0	0	372
3841	291.00	1714.00	1714.00	0	0	0	613	6133	0	0	0	6133	0	0	0	0	158
3841	305.60	10002.00	5291.58	0	0	40	705	33361	0	0	0	33361	0	0	0	17	705
3841	342.00	264.00	264.00	0	0	0	14	540	0	0	0	540	0	0	0	0	0
3841	347.00	4200.00	4200.00	0	0	0	24	3890	0	0	0	3890	0	0	0	0	13
3841	365.00	6900.00	6900.00	0	0	12	643	16151	0	0	0	16151	0	0	0	0	160
2834	378.00	9676.00	9676.00	0	0	73	2896	51242	0	0	0	51242	0	0	0	18	1018
3841	400.00	111.00	111.00	0	0	0	0	144	0	0	0	144	0	0	0	0	0
2099	400.00	40320.00	40320.00	0	0	262	12527	845446	0	0	0	845446	0	0	0	262	7320
2099	401.00	686.00	686.00	0	0	0	0	120	0	0	0	120	0	0	0	0	0
3841	410.00	5739.00	5739.00	0	0	561	4255	41017	0	0	0	41017	0	0	0	0	2970
3841	410.00	3120.00	3120.00	0	0	0	124	11176	0	0	0	11176	0	0	0	0	19
3841	440.00	1965.00	1965.00	0	0	8	286	9186	0	0	0	9186	0	0	0	0	109
3841	479.20	5088.00	5088.00	0	0	21	1802	41915	0	0	0	41915	0	0	0	0	899
8411	486.00	105.00	105.00	0	0	0	0	1616	0	0	0	1616	0	0	0	0	0
7399	487.00	4320.00	4320.00	0	0	6	129	1448	0	0	0	1448	0	0	0	0	68
3841	496.60	12249.00	12249.00	0	0	263	2199	73437	0	0	0	73437	0	0	0	0	1706
3841	500.00	5250.00	5250.00	0	0	330	4638	42762	0	0	0	42762	0	0	0	0	3556
3841	500.00	2450.00	2450.00	0	0	18	862	12660	0	0	0	12660	0	0	0	0	96
3841	520.00	7194.00	7194.00	0	0	0	166	35560	0	0	0	35560	0	0	0	0	39
2099	524.00	1300.00	1300.00	0	0	0	277	3520	0	0	0	3520	0	0	0	0	28
2099	540.00	4667.00	4667.00	0	0	23	5027	90049	0	0	0	90049	0	0	0	8	2070
3841	540.00	11440.00	5777.20	0	0	18	401	37826	0	0	0	37826	0	0	0	18	401
7399	557.00	1334.00	1334.00	0	0	0	217	3808	0	0	0	3808	0	0	0	0	81
2099	560.00	3640.00	3640.00	0	0	6	309	30988	0	0	0	30988	0	0	0	0	43
2099	566.00	2280.00	2280.00	0	0	4	163	7804	0	0	0	7804	0	0	0	0	99
7399	567.00	3240.00	3240.00	0	0	20	729	34522	0	0	0	34522	0	0	0	0	385
7399	568.00	19090.00	19090.00	0	0	96	2368	90084	0	0	0	90084	0	0	0	18	725
7399	570.00	6176.00	6176.00	0	0	267	7798	69473	0	0	0	69473	0	0	0	0	2280
3841	580.00	14352.00	14352.00	0	0	322	2749	108874	0	0	0	108874	0	0	0	106	1446
2099	600.00	6000.00	6000.00	0	0	101	4515	54226	0	0	0	54226	0	0	0	46	4148
2834	600.00	4200.00	4200.00	0	0	11	2382	44615	0	0	0	44615	0	0	0	0	1273
7399	600.00	8400.00	8400.00	0	0	103	2818	54708	0	0	0	54708	0	0	0	6	1289
3841	612.00	10800.00	10800.00	0	0	1	520	7039	62211	0	0	62211	0	0	0	124	3929
3841	615.00	41200.00	41200.00	0	0	62	12341	49207	0	0	0	49207	0	0	0	66	4513
2099	640.00	21240.00	21240.00	0	0	1	62	8696	60076	0	0	60076	0	0	0	8	1038
2834	643.50	4368.00	2205.84	0	0	0	0	583	4139	0	0	4139	0	0	0	0	583
2099	658.00	14862.00	14862.00	0	0	179	13763	152986	0	0	0	152986	0	0	0	83	7711
3841	667.00	15600.00	15600.00	0	0	393	4382	14981	0	0	0	14981	0	0	0	43	2957
3841	675.00	2016.00	1011.02	0	0	0	0	37	2427	0	0	2427	0	0	0	0	23

TABLE B-3. (continued)

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SIC	SIZE	TOT	ED	TOT	BAS	ED	EH	BASEPOP2	BASEPOP3	BASEPOP4	BASEPOP5	BASEPOP6	COMPOP2	COMPOP3	COMPOP4	COMPOP5	COMPOP6
3841	675.00	1521.00	0	0	0	0	0	0	0	0	0	3591	0	0	0	0	0
3841	698.00	7387.00	0	0	17	836	1393	0	0	0	0	0	0	0	0	2	154
2099	750.00	2527.00	0	0	0	0	1014	19280	0	0	0	0	0	0	0	0	587
3841	770.50	4286.90	0	0	81	1552	33631	0	0	0	0	0	0	0	0	27	1284
2834	800.00	14400.00	0	0	0	0	3673	46075	0	0	0	0	0	0	0	0	1658
3841	810.00	7350.00	0	0	283	2075	67366	0	0	0	0	0	0	0	0	0	1554
3841	852.00	18268.00	0	0	0	0	102	0	0	0	0	0	0	0	0	0	0
7391	975.00	35040.00	0	0	471	10729	116230	0	0	0	0	0	0	0	0	243	8828
2099	1000.00	40800.00	0	3	170	24773	554766	0	0	0	0	0	0	0	0	48	23672
3841	1000.00	14860.00	0	0	100	7719	94603	0	0	0	0	0	0	0	0	28	2501
7399	1000.00	8736.00	0	0	1520	16151	135061	0	0	0	0	0	0	0	0	318	8193
3841	1000.00	5016.00	0	0	24	654	21095	0	0	0	0	0	0	0	0	0	272
2099	1000.00	1155.00	0	0	0	1622	28956	0	0	0	0	0	0	0	0	0	422
7399	1009.61	12020.00	0	0	22	483	49697	0	0	0	0	0	0	0	0	6	241
3841	1044.00	15040.00	0	0	27	431	7484	0	0	0	0	0	0	0	0	9	416
3841	1045.00	18653.00	0	1	143	4035	52646	0	0	0	0	0	0	0	0	9	745
2099	1066.00	804.00	0	0	0	397	6421	0	0	0	0	0	0	0	0	0	53
3841	1100.00	24120.00	0	0	14	904	94608	0	0	0	0	0	0	0	0	8	431
3841	1102.00	21911.00	0	2	136	8267	583744	0	0	0	0	0	0	0	0	33	5967
7399	1128.00	1800.00	0	0	0	60	1692	0	0	0	0	0	0	0	0	0	6
2834	1160.00	24082.00	0	0	720	23143	296703	0	0	0	0	0	0	0	0	720	23143
2099	1238.00	2419.20	0	0	0	2394	13990	0	0	0	0	0	0	0	0	0	2224
2099	1248.00	36000.00	0	15	202	35105	108515	0	0	0	0	0	0	0	0	103	18131
2834	1248.00	6451.00	0	0	0	582	53558	0	0	0	0	0	0	0	0	0	0
3841	1266.00	22560.00	0	0	208	7386	16654	0	0	0	0	0	0	0	0	33	1818
3841	1300.00	11400.00	0	0	195	5000	73042	0	0	0	0	0	0	0	0	73	2087
3841	1334.00	108000.00	0	0	3	2683	94576	0	0	0	0	0	0	0	0	3	3942
3841	1358.00	11547.00	0	0	618	7227	94208	0	0	0	0	0	0	0	0	298	4676
3841	1475.00	21135.00	0	0	158	6602	513404	0	0	0	0	0	0	0	0	15	5467
2834	1545.00	24000.00	0	1	46	773	23434	0	0	0	0	0	0	0	0	13	507
7399	1575.00	93450.00	0	494	7865	72862	820315	0	0	0	0	0	0	0	0	3686	36617
3841	1608.00	126208.00	0	32	3209	176761	4003843	0	0	0	0	0	0	0	5	3209	201961
7399	1675.00	13000.00	0	0	29	1464	8740	0	0	0	0	0	0	0	0	5	851
2099	1745.00	5850.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7399	1751.00	41320.00	0	0	22	5904	378001	0	0	0	0	0	0	0	0	0	2253
3841	1874.90	16426.00	0	0	535	8201	199642	0	0	0	0	0	0	0	0	145	3811
7399	1904.00	11016.00	0	0	577	10046	242589	0	0	0	0	0	0	0	0	28	3933
2834	1907.70	23954.00	0	0	137	3671	131140	0	0	0	0	0	0	0	0	49	1775
3841	1915.00	39105.00	0	0	0	15223	879407	0	0	0	0	0	0	0	0	0	6516
2834	1974.00	18057.00	0	0	679	7605	116231	0	0	0	0	0	0	0	0	336	5006
3841	1998.00	16956.00	0	0	203	3886	17835	0	0	0	0	0	0	0	0	43	1936
7399	2000.00	15724.00	0	0	0	0	48065	0	0	0	0	0	0	0	0	0	0
3841	2000.00	63600.00	0	85	1434	29643	486054	0	0	0	0	0	0	0	0	1185	18350
3841	2001.00	60747.00	0	9	436	5486	332349	0	0	0	0	0	0	0	2	420	6908
3841	2004.00	84030.00	0	3	310	1977	6590	0	0	0	0	0	0	0	0	326	1977
2099	2080.00	130000.00	0	6	262	20889	601352	0	0	0	0	0	0	0	0	256	20889
7399	2365.00	66503.00	0	0	681	75854	1304952	0	0	0	0	0	0	0	0	481	74752
2099	2370.00	13000.00	0	0	298	7410	357025	0	0	0	0	0	0	0	0	147	2802
7399	2400.00	24000.00	0	0	44	3927	284323	0	0	0	0	0	0	0	0	3	709
2834	2444.00	8390.00	0	0	30	886	9046	0	0	0	0	0	0	0	0	30	997
3841	2534.00	26549.00	0	0	7	145	5539	0	0	0	0	0	0	0	0	4	167
3841	2574.00	121888.00	0	524	11564	133010	998763	0	0	0	0	0	0	0	198	8679	62294
3841	2668.00	132000.00	0	535	4872	45348	954629	0	0	0	0	0	0	0	128	4536	48722
2834	2710.00	176000.00	0	41	4137	22592	275493	0	0	0	0	0	0	0	6	2230	22592
2834	2828.00	82720.00	0	202	3186	30241	102894	0	0	0	0	0	0	0	104	3206	35709

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TABLE B-3. (continued)

SIC	SIZE	TOT	ED	TOT	BAS	ED	EH	BASEPOP2	BASEPOP3	BASEPOP4	BASEPOP5	BASEPOP6	COMP2	COMP3	COMP4	COMP5	COMP6
3841	2980.00	36192.00	18188.49	0	0	120	2755	58148	0	0	0	0	0	0	0	94	2755
3841	3001.00	78006.00	78006.00	0	12	1771	32141	579651	0	0	8	1771	30444	0	0	185	20362
3841	3024.00	42009.00	42009.00	0	28	1826	21449	103562	0	0	0	0	0	0	0	483	9839
2822	3180.00	57600.00	57600.00	0	27	1043	21120	929160	0	0	0	0	0	0	14	6457	38359
2834	3200.00	147000.00	147000.00	2	99	8335	96431	350155	0	0	0	0	0	0	0	35	5071
2834	3359.00	96474.00	63077.40	0	2	344	7820	254288	0	0	0	0	0	0	0	22	1087
2834	3600.77	68941.00	34733.49	0	1	24	1066	11157	0	0	0	0	0	0	0	30	481
3841	3606.00	61710.00	36100.35	0	3	47	481	24831	0	0	0	0	0	0	23	1424	21105
3841	3950.00	92600.00	92600.00	0	127	2612	34077	82022	0	0	0	0	0	0	0	33	2908
2099	3955.00	29700.00	14998.50	0	0	34	2403	58830	0	0	0	0	0	0	0	13	1512
3841	4000.00	32040.00	16036.02	0	0	26	1566	31027	0	0	0	0	0	0	0	0	5782
3841	4002.00	149000.00	149000.00	0	0	135	2045	8426	0	0	0	0	0	0	0	92	2471
3841	4075.00	29500.00	15340.00	0	0	79	1897	35474	232059	0	0	0	0	0	24	2159	39389
3841	4200.00	86950.00	48758.15	0	11	5077	484091	5314213	0	0	0	0	0	0	3	4284	240778
7399	4235.00	134680.00	134680.00	0	281	4741	70692	2843770	0	0	0	0	0	0	79	2120	39495
7399	4681.00	137778.00	137778.00	0	0	443	11132	239352	0	0	0	0	0	0	0	443	11132
7399	4696.00	43050.00	43050.00	0	32	9885	142663	806318	0	0	0	0	0	0	15	4424	99546
7399	4725.00	237300.00	196980.00	0	7	999	6171	57418	0	0	0	0	0	0	1	469	6171
3841	5006.00	160030.00	160030.00	0	10	3242	26046	132554	0	0	0	0	0	0	6	1369	22249
3841	5202.00	149200.00	149200.00	0	0	0	5125	305220	0	0	0	0	0	0	0	0	2835
3841	6000.70	240030.00	240030.00	0	0	1	19	403	9670	0	0	0	0	0	0	15	1562
3841	7318.00	41760.00	21297.60	0	94	1366	12473	277906	0	0	0	0	0	0	7	1056	8471
3841	7434.00	110614.00	110614.00	0	587	16469	196005	2781458	0	0	0	0	0	0	564	20003	245192
2834	8120.00	215697.00	108882.85	0	429	6293	40999	510189	0	0	0	0	0	0	389	7366	48513
3841	9598.40	101976.00	51497.92	0	0	12	142	987253	0	0	0	0	0	0	0	426	36607
7399	9800.00	58800.00	29694.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0

CONTACT REPORT--MRI Project No. 7701

From: Joanna Larson, Environmental Engineering Department

Date of Contact: February 9, 16, and 17, 1988

Contacted by: Telephone

Company/Agency: Damas Corporation
8 Romanelli Avenue
South Hackensack, New Jersey

Telephone Number: (201) 489-0525

Person(s) Contacted/Title(s)

Ms. Pat Zaccario, Sales Manager
Mr. David Smith, President

RECEIVED	
CONFIRMATION	REQUESTED 2/24/88
AUG 23 1997	
RESPONSE	RECEIVED 3/3/88
DOCKET CONTROL ROOM 07606	
REVISED PER COMMENTS	
WRITTEN <input checked="" type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Ms. Zaccario stated that the amount of electricity need^{ed} to run a Damas Tri-phase scrubber was minimal because there are no moving parts to a scrubber. Operating electricity is needed just to run a small control panel (i.e., just a few lights) and would be 110 volts, at 20 amps. The total amount of electricity needed would depend on how many times the sterilizer is operated (i.e., the number of sterilizer cycles) and would be different for every installation. Ms. Zaccario noted that when the sterilizer is run, a facility would have to activate blowers and fans (both of which are not sold by Damas) but that there are no moving parts on the scrubber.

Mr. Smith said that when a sterilizer is exhausting, electricity would be needed to work a few valves and a roof fan. He estimated that approximately 40 amps of 110 volt electricity would be needed for 1 hour during a sterilizer cycle. (This 1-hour estimate is based on the use of a large sterilizer; a very large sterilizer might require several hours to exhaust, while a small sterilizer may require only 15 to 20 minutes.) He estimated the cost of electricity for this 1-hour period to be \$5. (He assumed that the facility is using a Damas Tri-phase scrubber Model 100, the basic model.) The number of cycles that a facility may run varies; eg., 3 times a day, once a week, or once or twice a week.

Mr. Smith suggested that I contact a local electric company and request a rate book because electric rates vary. He noted that I should look at the cost of 40 amps of 110 volt power for 1 hour (of single-phase power).

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AUG 7 1987

DOCKET CONTROL ROOM

II < E 302
DRAFT
FINAL

CONTACT REPORT--MRI Project CONFIRMATION REQUESTED.

From: Joanna Larson, Environmental Engineering Department

Date of Contact: February 17, 1988

Contacted by: Telephone

Company/Agency: Chemrox, Inc.
~~Commerce Park~~ 217 Long Hill Crossroads
~~4695 Main Street~~ Shelton, CT 06484
~~Bridgeport, Connecticut~~ 06606

Telephone Number: (203) 926-9081

Person(s) Contacted/Title(s)
 Mr. Pankaj Desai, ~~Technical Advisor~~ VP, Sales & Marketing

CONTACT SUMMARY:

Mr. Desai stated that his comments would be based strictly on the model they sell; the EO-VAC²™ Closed loop vacuum pump system. This system is a closed water sealed system that employs neutral (not acidic or alkaline) water. Under these neutral conditions, not much of the ethylene oxide (EO) in the recirculating water converts into ethylene glycol because it offgases and evaporates.

Although Mr. Desai stated that only a very minimum amount of EO in the recirculating water converts to ethylene glycol, he was unwilling to speculate about the size of that amount because the company has not taken any measurements.

He also stated that there is no regular dumping of the recirculating water. A small overflow tank, a 5-gallon tank, is attached to the EO-VAC²™ system to catch any excess liquid from the system. The sterilizer system uses moisture which can condense in the vacuum pump as the sterilizing gas is passed through the system. Any liquid volume exceeding the normal level passes to the overflow tank. The amount of extra liquid bypassed/dumped depends on the moisture level settings of the sterilizer and the frequency of sterilizer cycles. This amount may be approximately 1 to 2 gallons per month but Mr. Desai stressed that there was no absolute dumping of the recirculating

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water.

Mr. Desai noted that the vapor pressure of ethylene glycol which may be formed from EO is lower than water, which is favorable. Again, he stressed that any dumping of recirculating water is driven by moisture condensing from the system and not by the amount of glycol made.

The overflow tank is vented to the same stack that carries gas coming off the vacuum pump (the line coming from the vacuum pump separator). The EO in the water offgases and there may be a few ppm of ethylene glycol in the overflow water when it is dumped from the overflow tank.

Mr. Desai thought that MRI may already have a product data sheet on the EO-VAC^{STM} closed loop vacuum pump system. Natalie Demay, sales assistant, can provide us with product data sheets if needed. [A copy of the product data sheet is attached.]

Pankaj R. Desai
3/2/88



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

A-88-03

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April 5, 1988

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AUG 23 1997

NOTICE OF MEETING

OAQPS AIR
DOCKET CONTROL ROOM

The United States Environmental Protection Agency's (EPA) National Air Pollution Control Techniques Advisory Committee (NAPCTAC) will meet on May 18 and 19, 1988, to review the subjects shown on the enclosed agenda. The meeting will be held at the Sheraton Imperial Hotel and Towers in Research Triangle Park, North Carolina.

The NAPCTAC meetings are always open to the public, and you are invited to attend and participate in the discussions. Enclosed is the preliminary draft document entitled, "Ethylene Oxide Emissions from Commercial Sterilization/Fumigation Operations-Background Information for Proposed Standards." Also, enclosed is a supplemental appendix to the document providing a summary of potential regulatory impacts as well as the methodology used to develop risks attributed to short-term exposures to ethylene oxide. The meeting was announced in the Federal Register on March 28, but we wanted you to have this information because of your interest in this subject.

In order to properly plan the meeting, it is necessary for me to know prior to the meeting if you plan to make a presentation. Please call Mary Jane Clark at (919) 541-5571 by May 10 if you would like to make a presentation. If you do plan a presentation, please bring a copy of it to the meeting for our use in preparing the meeting minutes. If you wish to distribute your presentation to the Committee and staff, 25 copies will be sufficient. Written comments are certainly welcome, and we can schedule a meeting with your association to discuss your comments if you so desire.

For your information, a block of rooms (special rate of \$60 a day) is being held at the Sheraton until May 2 for use by those who wish to stay where the meeting is being held. When making your reservations, please indicate that you will be attending the EPA meeting; the telephone number is (919) 941-5050. The Sheraton does provide a courtesy airport limousine.

Sincerely,

Jack R. Farmer
Chairperson

National Air Pollution Control
Techniques Advisory Committee

3 Enclosures

IDENTICAL LETTERS SENT TO 39 INDIVIDUALS (LIST ATTACHED TO OFFICIAL FILE)

April 5, 1988

A-88-03

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Sincerely,

15/

Jack R. Farmer
Chairperson
National Air Pollution Control
Techniques Advisory Committee

3 Enclosures

OAQPS: ESD: OD: MJClark: mjclark, rm 741, NCM, x5571 (MD-13): 4/5/88
bcc: Dave Markwordt, ESD/CPB (3 copies: CPB file and 2 for docket)
Laura Butler, ESD/SDB

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AGENDA

U. S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Sheraton Imperial Hotel and Towers
Empire Ballroom (A and B)
I-40 Exit 282 at Page Road
Research Triangle Park, North Carolina 27709

(919) 941-5050

MAY 18 AND 19, 1988

May 18 (Wednesday) - 9:00 a.m.

ASPHALT ROOFING
Review of Standards of Performance for New Stationary Sources
(Section 111 of the Clean Air Act)

VOLATILE ORGANIC COMPOUNDS (VOC's) CAPTURE EFFICIENCY
Test Methods and Procedures
(Sections 110 and 111 of the Clean Air Act)

MUNICIPAL WASTE COMBUSTION
Status Report to the Committee on Regulatory Development
(Sections 111 and 111(d) of the Clean Air Act)

MUNICIPAL SOLID WASTE LANDFILLS
Background Information and Regulatory Alternatives
(Sections 111 and 111(d) of the Clean Air Act)

TREATMENT, STORAGE, AND DISPOSAL FACILITIES (TSDF)
Background Information and Regulatory Alternatives
(Resource Conservation and Recovery Act)

May 19 (Thursday) - 9:00 a.m.

PERCHLOROETHYLENE DRY CLEANING
Background Information and Regulatory Alternatives
(Section 112 of the Clean Air Act)

ETHYLENE OXIDE COMMERCIAL STERILIZERS
Background Information and Regulatory Alternatives
(Section 112 of the Clean Air Act)

SMALL STEAM GENERATING UNITS
Status Report to the Committee on Regulatory Development
(Section 111 of the Clean Air Act)

Note: See reverse for current roster of the Committee.

5/18/88

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1.0 INTRODUCTION

The EPA announced an intent to list ethylene oxide (EO) as a hazardous air pollutant under Section 112 of the Clean Air Act on October 2, 1985 (50 FR 40286). As a result, a standard for regulating EO emissions from commercial sterilization facilities is under development. The standard-setting process involves the identification of commercial sterilization sources of EO emissions and the development of options for controlling them. The selection of a standard is based on an evaluation of the environmental (air and nonair) and health impacts of the control options. This document provides the background information necessary for this evaluation of EO emissions from sterilization chamber vents, vacuum pump drains, and aeration rooms.

2. THE COMMERCIAL STERILIZATION INDUSTRY PROCESSES AND POLLUTANT EMISSIONS

2.1 SOURCE CATEGORY DESCRIPTION

The commercial sterilization source category covers the use of ethylene oxide (EO) as a sterilant/fumigant in the production of medical equipment supplies and in miscellaneous sterilization and fumigation operations. Sterilization operations at hospitals, which are under investigation as a separate source category, are not included in this document. Available information indicates that EO is used at over 200 commercial sterilization facilities in the U.S.^{1,2} These facilities use EO as a sterilant for heat- or moisture-sensitive materials or as a fumigant to control microorganisms or insects. A variety of materials are sterilized or fumigated with EO, including medical equipment (e.g., syringes and surgical gloves), spices, cosmetics, and pharmaceuticals. These materials may be sterilized at the facility that produces the sterile product or by contract sterilizers (i.e., firms under contract to sterilize products manufactured by other companies). Libraries and museums use EO to fumigate books and other historical items. State departments of agriculture control bee diseases with EO by fumigating beehives.

The information available to EPA for the commercial sterilization source category was taken from the following two sources: (1) a survey of medical equipment suppliers conducted by the Health Industry Manufacturer's Association (HIMA) in 1985 and (2) information requests submitted by EPA under Section 114 of the Clean Air Act to miscellaneous sterilizers and fumigators in 1986.^{1,2} The miscellaneous sterilization and fumigation facilities were identified during an extensive survey of potential EO users. As shown in Table 2-1, the facilities that comprise

TABLE 2-1. LOCATIONS OF FACILITIES--EPA
COMMERCIAL STERILIZATION DATA BASE^{1,2}

State	No. of facilities		No. of facilities
Arizona	3	Missouri	5
California	21	New Hampshire	2
Colorado	3	New Jersey	18
Connecticut	6	New York	14
Delaware	2	North Carolina	7
Florida	5	Ohio	2
Georgia	4	Pennsylvania	10
Illinois	8	Puerto Rico	14
Indiana	4	Rhode Island	2
Iowa	3	South Carolina	3
Maryland	5	Tennessee	3
Massachusetts	9	Texas	11
Michigan	8	Utah	2
Minnesota	6	Virginia	5
Mississippi	<u>2</u>	Washington	<u>2</u>
Subtotal	89	Subtotal	100
The commercial sterilization data base includes one facility located in each of the following States: Alabama, Alaska, Arkansas, Hawaii, Kentucky, Maine, Nebraska, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Wisconsin, West Virginia.			
Subtotal	14		
Total No. of facilities	203		

the EPA commercial sterilization data base are located in 43 States and Puerto Rico. The facilities were grouped by Standard Industrial Classification (SIC) into the following categories:

1. medical equipment suppliers;
2. pharmaceuticals;
3. other health-related industries;
4. spice manufacturers;
5. contract sterilizers;
6. libraries, museums, and archives;
7. laboratories (research, testing, and animal breeding); and
8. State departments of agriculture.³

Table 2-2 shows the number of facilities in the commercial sterilization data base for the eight categories listed above. Table 2-2 also shows the SIC codes represented by these industry categories.

2.2 PROCESS DESCRIPTION

There are two types of sterilization processes used at commercial sterilization facilities: (1) bulk sterilization and (2) single-item sterilization. These processes are described below followed by a discussion about the beehive fumigators used by State departments of agriculture. (In addition to using the bulk sterilization process, one facility also sterilizes within a 55-gallon drum.² This process, which is neither bulk nor single-item sterilization, is not discussed.)

2.2.1 Bulk Sterilization

Bulk sterilization is the more commonly used sterilization process; 98 percent of the facilities represented in the commercial sterilization data base use this process.^{1,2} The products to be sterilized are placed in a sterilization chamber and are exposed to a sterilant gas at a predetermined temperature, humidity level, and pressure. The equipment, sterilant gases, and sterilization cycle used for bulk sterilization processes are described below.

2.2.1.1 Equipment. A schematic of a gas sterilizer is shown in Figure 2-1. The main components of the sterilizer are the chamber and vacuum pump. Chambers used by commercial sterilization facilities typically range in volume from 2.8 cubic meters (m^3) (100 cubic feet [ft^3]) to 28 m^3 (1,000 ft^3).^{1,2} Table 2-3 presents size data for the

TABLE 2-2. NUMBER OF FACILITIES AND STANDARD INDUSTRIAL CLASSIFICATION (SIC) PER INDUSTRY CATEGORY--EPA COMMERCIAL STERILIZATION DATA BASE³

Industry category	No. of facilities	SIC
Medical equipment suppliers	64	3841, 3842
Pharmaceuticals	40	2834, 5122, 2831, 2833
Other health-related industries	25	3079, 3693, 5086, 2211, 2821, 2879, 3069, 3569, 3677, 3999
Spice manufacturers	25	2099, 5149, 2034, 2035, 2046
Contract sterilizers	17	7399, 7218, 8091
Libraries, museums, and archives	13	8411, 8231
Laboratories (research, testing, and animal breeding)	11	0279, 7391, 8071, 8922, 7397
State departments of agriculture	<u>8</u>	9641
Total	203	

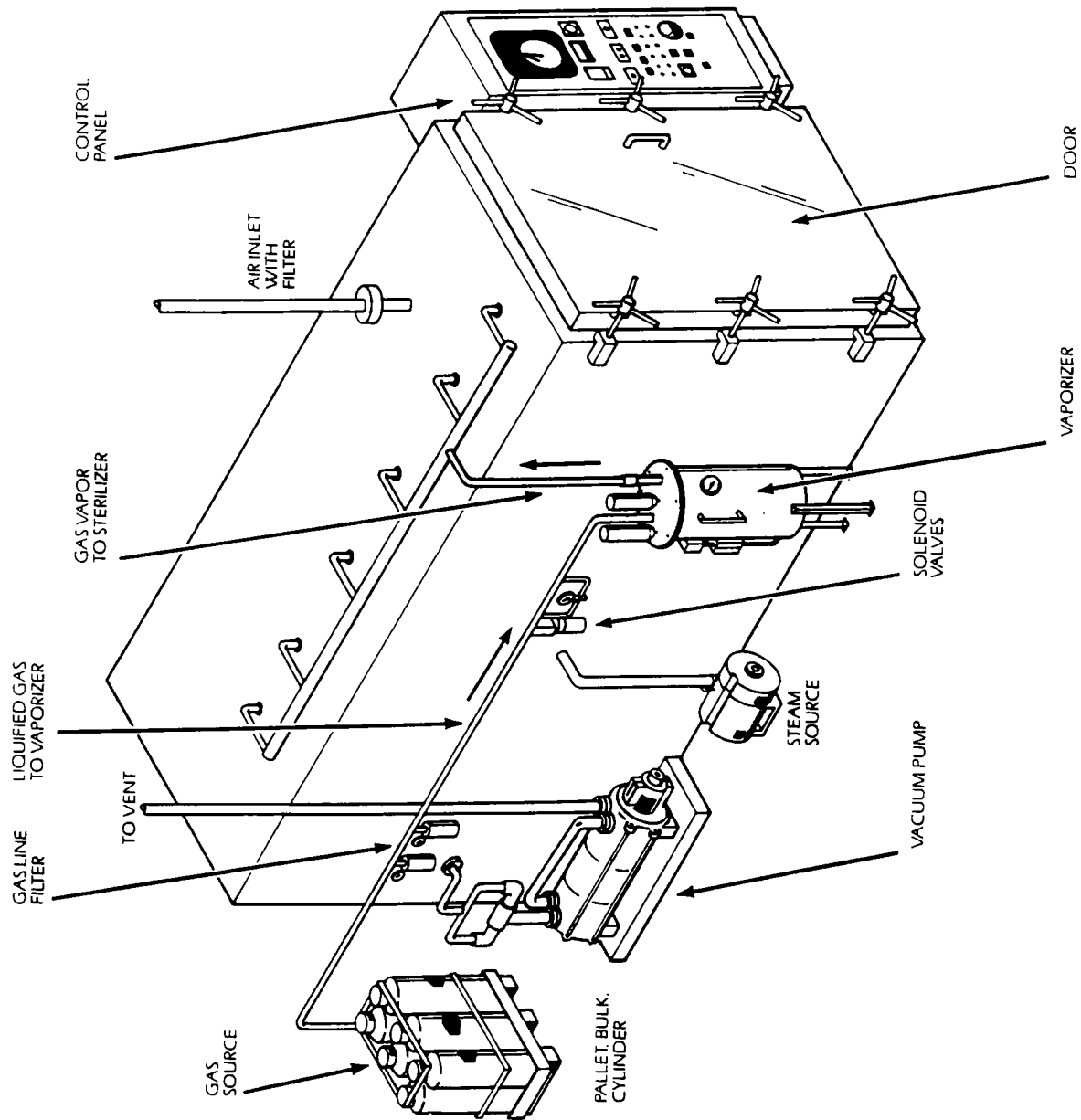


Figure 2-1. Schematic of a gas sterilizer. (Courtesy of Union Carbide Corporation, Linde Division.)⁵

TABLE 2-3. CHAMBER SIZES--EPA COMMERCIAL STERILIZATION DATA BASE^{1,2}

Size range, m ³ (ft ³)	No. of chambers	Percent	Cumulative No. of chambers	Cumulative, percent
≤1.4 (≤50)	87	20	87	20
1.5-2.8 (51-100)	29	7	116	27
2.9-14 (101-500)	111	26	227	53
15-28 (501-1,000)	130	29	357	84
29-57 (1,001-2,000)	60	14	417	98
≥58 (≥2,001)	10	2	427 ^a	100

^aThis number excludes four single-item sterilization units, one 55-gal drum user, and two facilities that did not report a chamber size.

chambers in the commercial sterilization data base. The vacuum pump is used to remove air from the chamber before sterilization begins and to evacuate the sterilant gas after the sterilization cycle is complete. Typically, a once-through, water-ring vacuum pump is used. Oil-sealed vacuum pumps or vacuum pumps that use recirculated water also are used. There is some indication that facilities are converting from once-through water-ring vacuum pumps to full sealant recovery vacuum pumps in order to meet the 1 part per million by volume (1 ppmv) Occupational Safety and Health Administration (OSHA) standard for EO.⁴

2.2.1.2 Sterilant Gases. Ethylene oxide is an extremely effective sterilant gas. The EO penetrates product packaging (e.g., cardboard shipping box, plastic shrink wrap, paper box, and final product wrapping) and destroys bacteria and viruses on the product. The product remains sterile until use because bacteria and viruses cannot penetrate the product wrapping.

The most widely used sterilant gas is a mixture of 12 percent by weight EO and 88 percent by weight dichlorodifluoromethane (CFC-12), referred to as 12/88. Two other commonly used sterilant gases are (1) pure EO (i.e., 100 percent EO) and (2) a mixture of 10 percent by weight EO and 90 percent by weight carbon dioxide (CO₂), referred to as 10/90. Physical and chemical properties of EO, CFC-12, and CO₂ are given in Table 2-4. Table 2-5 shows the number of facilities in the commercial sterilization data base using a particular gas type and the amount of EO used for each gas type. Since many facilities operate more than one sterilization chamber, the gas usage rates in Table 2-5 also are presented on a chamber basis.^{1,2}

The 12/88 mixture is the most popular sterilant gas for several reasons. Unlike pure EO, 12/88 is nonflammable and nonexplosive. Therefore, the use of 12/88 does not require explosion-proof rooms and additional safety precautions that are necessary when pure EO is used. The 10/90 mixture also is nonflammable and nonexplosive.⁵ But, because 10/90 is only 10 percent EO by volume whereas 12/88 is 27.3 percent EO by volume, 10/90 requires higher operating pressures to obtain an EO concentration that is sufficient for effective sterilization.⁶ The chambers used for 10/90 sterilization must be ASME-rated pressure vessels

TABLE 2-4. PHYSICAL AND CHEMICAL PROPERTIES OF ETHYLENE OXIDE, DICHLORODIFLUOROMETHANE,
AND CARBON DIOXIDE^{9,16-18}

	Ethylene oxide	Dichlorodifluoromethane	Carbon dioxide
Other designations	1,2-epoxyethane, oxirane, dimethylene oxide	CFC-12, refrigerant 12, propellant 12	Carbonic acid gas, carbonic anhydride
Appearance	Colorless liquid or gas	Colorless gas, readily liquified under pressure and/or cooling	Colorless gas
Chemical formula	C ₂ H ₄ O	CCl ₂ F ₂	CO ₂
Molecular weight	44.0	120.9	44.0
Vapor pressure at 20°C (68°F)	146.0 kPa (21.2 psia)	567.6 kPa (82.3 psia)	5,731.0 kPa (831 psia)
Boiling point at 101.3 kPa (14.7 psi)	10.4°C (50.7°F)	-29.8°C (-21.6°F)	-78.5°C (-109.3°F)
Flammability limits in air	Lower 3 percent by volume Upper 80+ percent by volume ^a	Nonflammable	Nonflammable
Water solubility	Completely miscible	Low solubility	--
Heat of combustion, vapor at 25°C (77°F)	1,306 kJ/mol (12,760 Btu/lb)	111 kJ/mol (396 Btu/lb)	--
Threshold limit value (TLV) 8-h time weighted average (TWA)	1 ppmv	1,000 ppmv	5,000 ppmv

^aPure EO explodes by decomposition at 560°C (1040°F) with ignition.

TABLE 2-5. STERILANT GAS TYPE USAGE--EPA COMMERCIAL STERILIZATION DATA BASE^{1, 2}

Sterilant gas	No. of facilities ^a	Percent of facilities	No. of chambers ^b	Percent of chambers	E0 use, Mg/yr ^c	Percent of total E0 use
12/88 (E0/CFC-12)	154	76	295	68	720	30
Pure E0	44	22	122	28	1,350	60
10/90 (E0/CO ₂)	14	7	19	4	4	<0.01
Other mixtures ^d	16	8	25	6	190	10

^aThere are 203 facilities in the commercial sterilization data base. Approximately 10 percent of these facilities use more than one type of sterilant gas.

^bThere are 434 operational sterilization "chambers" (the four single-item sterilization systems and the 55-gal drum systems are counted as chambers) in the commercial sterilization data base. More than one type of sterilant gas is used in 5 percent of these chambers.

^cAmount of E0 in the sterilant gas mixture.

^dIncludes mixtures of E0 and CO₂ with a weight percent of E0 ranging from 20 to 80 percent and custom mixes.

and are, therefore, more expensive to construct than the chambers used with 12/88. (However, because of insurance requirements, many facilities must use chambers that meet requirements for ASME-rated pressure vessels when sterilizing with 12/88 or with explosive mixtures below ambient pressure.)⁷

2.2.1.3 Sterilization Cycle. The typical sterilization cycle consists of five phases: (1) presterilization conditioning, (2) sterilization, (3) evacuation, (4) air wash, and (5) aeration. Figures 2-2 and 2-3 show pressure/time curves for the first four phases of the 12/88 sterilization cycle and the pure E0 sterilization cycle, respectively.

2.2.1.3.1 Presterilization conditioning. After the products have been loaded into the chamber and the airtight door sealed, a partial vacuum is drawn inside the chamber. This initial vacuum, or drawdown, prevents dilution of the sterilant gas. Also, if flammable sterilant gases are used, the removal of air reduces the potential for ignition.⁵ The chamber pressure is reduced to a pressure of about 6.9 to 69 kilopascals (kPa) (1 to 10 pounds per square inch absolute [psia]) for 12/88 and 3 kPa (0.4 psia) for pure E0. The initial drawdown takes from about 5 to 45 minutes, depending on the product being sterilized. Certain products require a longer drawdown time because they are damaged by sudden pressure changes. The chamber temperature is then adjusted to between 38°C (100°F) and 54°C (130°F). A higher temperature will reduce the time the products must be exposed to the sterilant gas to ensure proper sterilization. Finally, the relative humidity is raised to about 45 percent by injecting steam. Proper humidification is important to the process because the susceptibility of microorganisms to the sterilant gas is increased under moist conditions.⁵

2.2.1.3.2 Sterilization. The sterilant, which is supplied as a liquid, is vaporized and introduced into the chamber to achieve the desired concentration of E0. The chamber pressure depends on the type of sterilant gas used. Pure E0 is used under a slight vacuum at pressures of about 94 kPa (13.7 psia); the 12/88 mixture is used at pressures of about 170 kPa (24.7 psia). The pressure is held for about 4 to 6 hours. This exposure time is dependent on the temperature, pressure, humidity level,

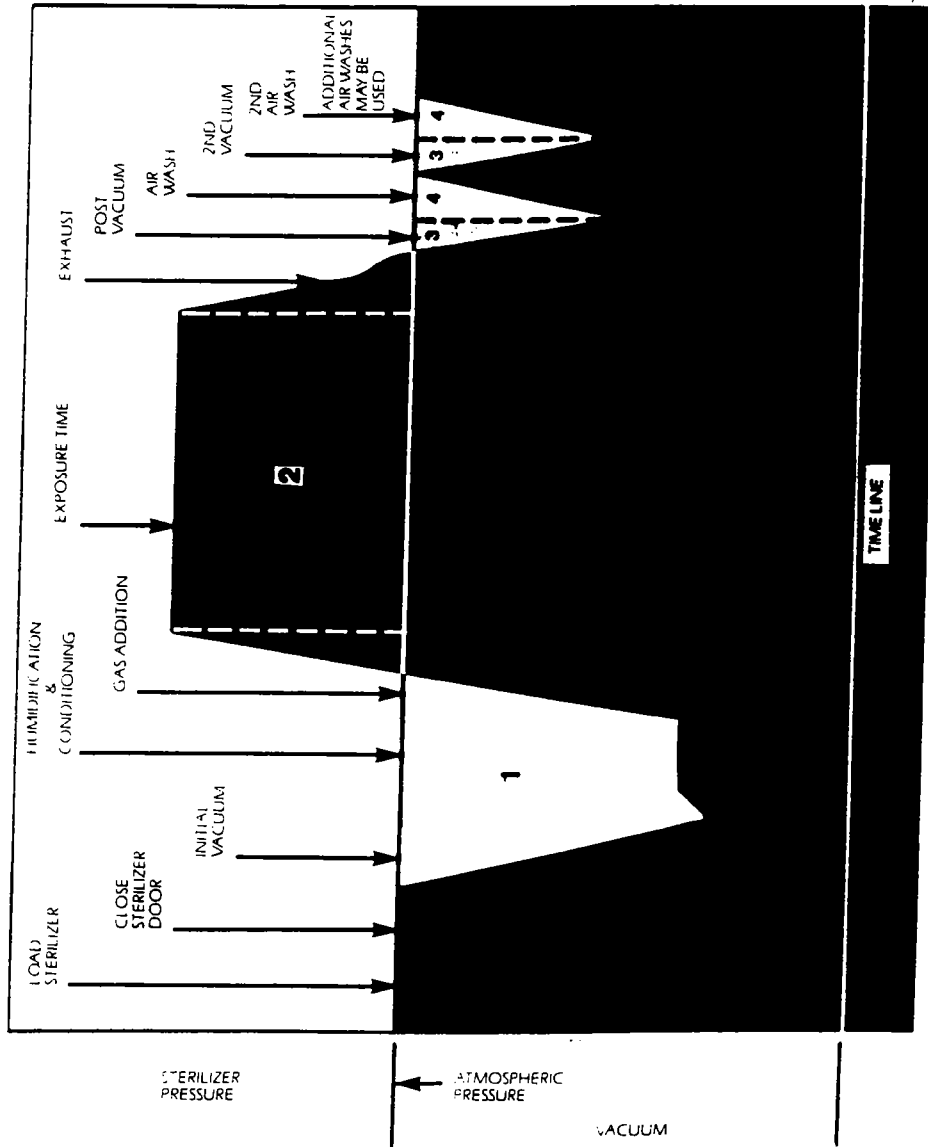


Figure 2-2. Sterilization cycle for 12/88. (Courtesy of Union Carbide Corporation, Linde Division.)⁵

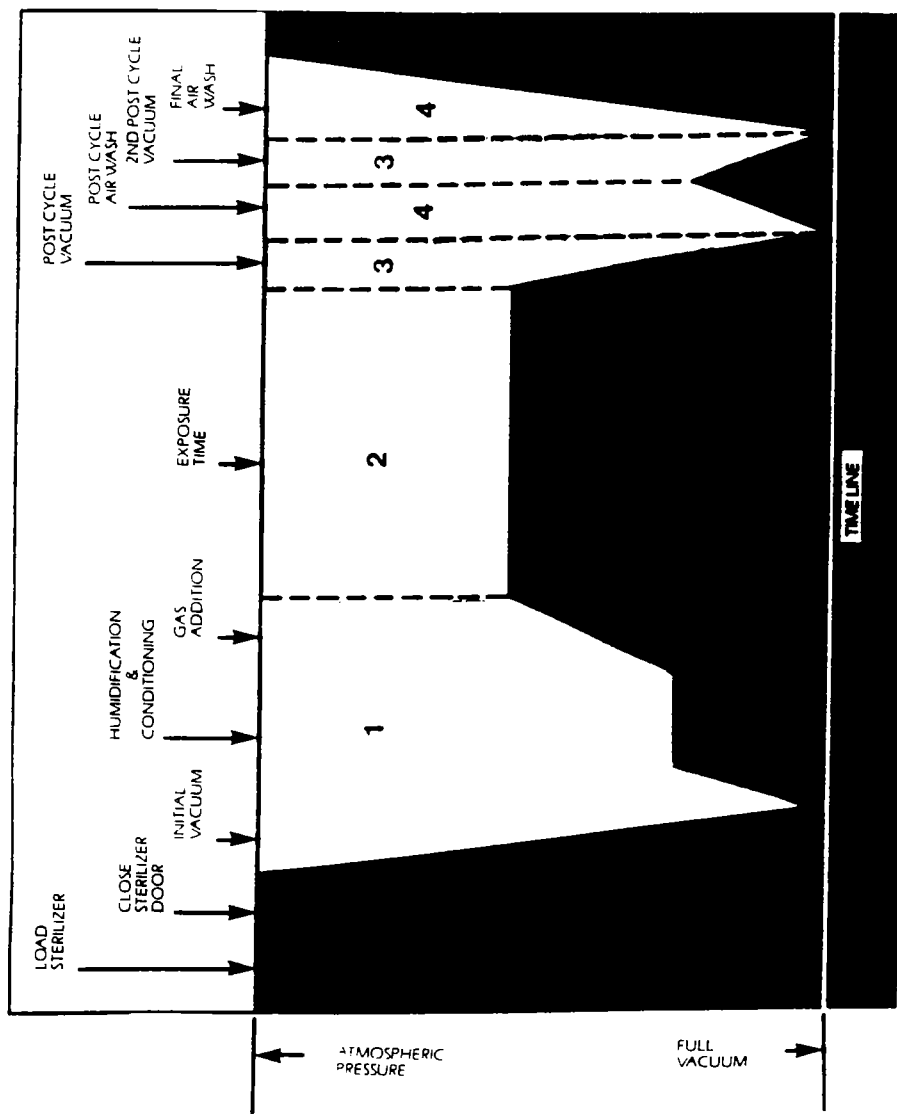


Figure 2-3. Sterilization cycle for pure E0. (Courtesy of Union Carbide Corporation, Linde Division.)⁵

type of sterilant gas, and products being sterilized. For example, porous products require shorter exposures than nonporous products. Also, some bacteria are more resistant to EO and take longer to destroy.

2.2.1.3.3 Evacuation. Following sufficient exposure time, the sterilant gas is evacuated from the chamber with a vacuum pump. Typical evacuation pressures are 13 kPa (1.9 psia) for 12/88 gas and 3 kPa (0.4 psia) for pure EO. This postcycle vacuum phase lasts about 10 minutes.

2.2.1.3.4 Air wash. The pressure in the chamber is brought to atmospheric pressure by introducing air (when nonflammable sterilant gases are used) or either nitrogen or CO₂ (when flammable sterilant gases are used). The purpose of the air wash is to allow residual EO to diffuse from the product. The air wash typically lasts 2 to 15 minutes.

The combination of evacuation and air wash phases is repeated from two to four times to remove as much of the EO from the product as possible. Removal of EO from the product during the air wash helps meet Food and Drug Administration guidelines on residual EO levels for medical devices, EPA residual tolerances for agricultural products, and the OSHA standard for exposure in the workplace.

2.2.1.3.5 Aeration. After the last air wash, the chamber doors are opened, and the sterile products are placed in an aeration room and kept there for several days. The purpose of aeration is to allow further diffusion of residual EO from the products prior to shipping. Ethylene oxide concentrations in the aeration room are maintained at relatively low levels by ventilating the room at a rate of about 20 air changes per hour.

Facilities that sterilize products infrequently may aerate in the sterilization chamber. Two basic chamber aeration processes are used. The first process involves cycling the chamber between atmospheric pressure and a slight vacuum pressure (i.e., a pressure of about 94 kPa [13.7 psia]) several times over a 12- to 24-hour period. The length of the cycles depends on the chamber size and vacuum pump capacity. The second process involves drawing an extreme vacuum (about 0.6 kPa [0.1 psia]) in the chamber and holding the vacuum for 24 to 48 hours.

2.2.2 Single-Item Sterilization System

Four facilities (2 percent) reported the use of a single-item sterilization system. Three of these facilities use the Sterijet® system manufactured by H. W. Andersen Products; one facility uses another patented system that is similar to the Sterijet® system.^{1,2} (None of these facilities reported the use of emission control devices.) In contrast to the bulk sterilization chambers used by most commercial sterilization facilities, these systems are designed to sterilize small individual items (such as medical equipment supplies) in sealed pouches. Marketing of these systems is primarily focused on hospital sterilization. The growth in the use of these systems by commercial sterilization facilities is uncertain.

The single-item sterilization systems consist of (1) a machine that delivers the sterilant gas through a nozzle, (2) flexible plastic pouches, and (3) an aeration cabinet. The process involves the following steps. The product to be sterilized is placed in a plastic pouch. With the open ends of the pouch sealed around the nozzle, a slight vacuum is drawn in the pouch followed by injection of a premeasured quantity of sterilant gas. The amount of sterilant gas injected depends on the size of the pouch. After the gas is injected, the nozzle is automatically withdrawn, and the pouch is heat sealed. The sealed pouches are placed directly into an aeration cabinet or temperature-controlled aeration room. The enclosed product is sterilized prior to the escape of the gas through the pouch, which is designed to retain the EO long enough to ensure proper sterilization. The products are sterilized for approximately 12 hours at about 50°C (122°F) and aerated for an additional 36 hours.⁸

2.2.3 Beehive Fumigators

The process for beehive fumigators is essentially the same as bulk sterilization; however, a unique feature of the fumigators warrants a separate discussion. Whereas the sterilization processes described above are performed at one location, six of the eight State departments of agriculture represented in the commercial sterilization data base use portable chambers to fumigate beehives. These fumigators are transported to and used at numerous and variable locations in each of the six States. The State departments of agriculture use an EO/CO₂ sterilant gas

mixture. Typically, a garden hose is connected to the fumigation chamber and is placed along the ground for venting the sterilant gas during the evacuation phase of the sterilization cycle.

2.3 EMISSION SOURCES

The three principal sources of emissions at commercial sterilization facilities are (1) the sterilization chamber vent, (2) the sterilization chamber vacuum pump drain (assuming that a once-through, water-ring vacuum pump is used), and (3) the aeration room vent. A schematic of these emission sources is shown in Figure 2-4. Other potential emission sources are equipment leaks and storage and handling. (For the purposes of developing emission estimates, emission sources were assumed to be the same for all sterilization processes [i.e., bulk, single-item, and the 55-gallon drums]).

2.3.1 Sterilization Chamber Vents

Sterilization chamber vent emissions are associated with the chamber vacuum pump. These vacuum pumps are typically once-through, liquid-ring designs that use water as the working fluid. During the evacuation phase of the sterilization cycle, a mixture of chamber gas and water is expelled from the pump to a centrifugal liquid-gas separator. In the separator, gas-phase EO is directed to a vent and emitted to the atmosphere. The liquids from the separator are directed to a sewer drain.

2.3.2 Sterilization Chamber Vacuum Pump Drains

Some of the EO that is released from the chamber during the evacuation phase enters the liquid-phase separator line with the vacuum pump water. Although some EO may be hydrolyzed to ethylene glycol, the conversion rate at ambient temperatures is extremely slow, requiring weeks for completion (see Figure 2-5).⁹ Also, EO is rapidly released from an aqueous solution when agitated.¹⁰ Therefore, virtually all of the EO that dissolves in the vacuum pump water is emitted from the water. The absorbed EO may be released at the 1-inch air break between the liquid pipe and drain (required by local plumbing codes) or may diffuse into other areas of the building as the water passes through the drain system. Any remaining EO would desorb into the head space of the sewer pipes (possibly creating flammable mixtures with air) and be emitted as it passes through the sewer or waste treatment systems.^{4,9}

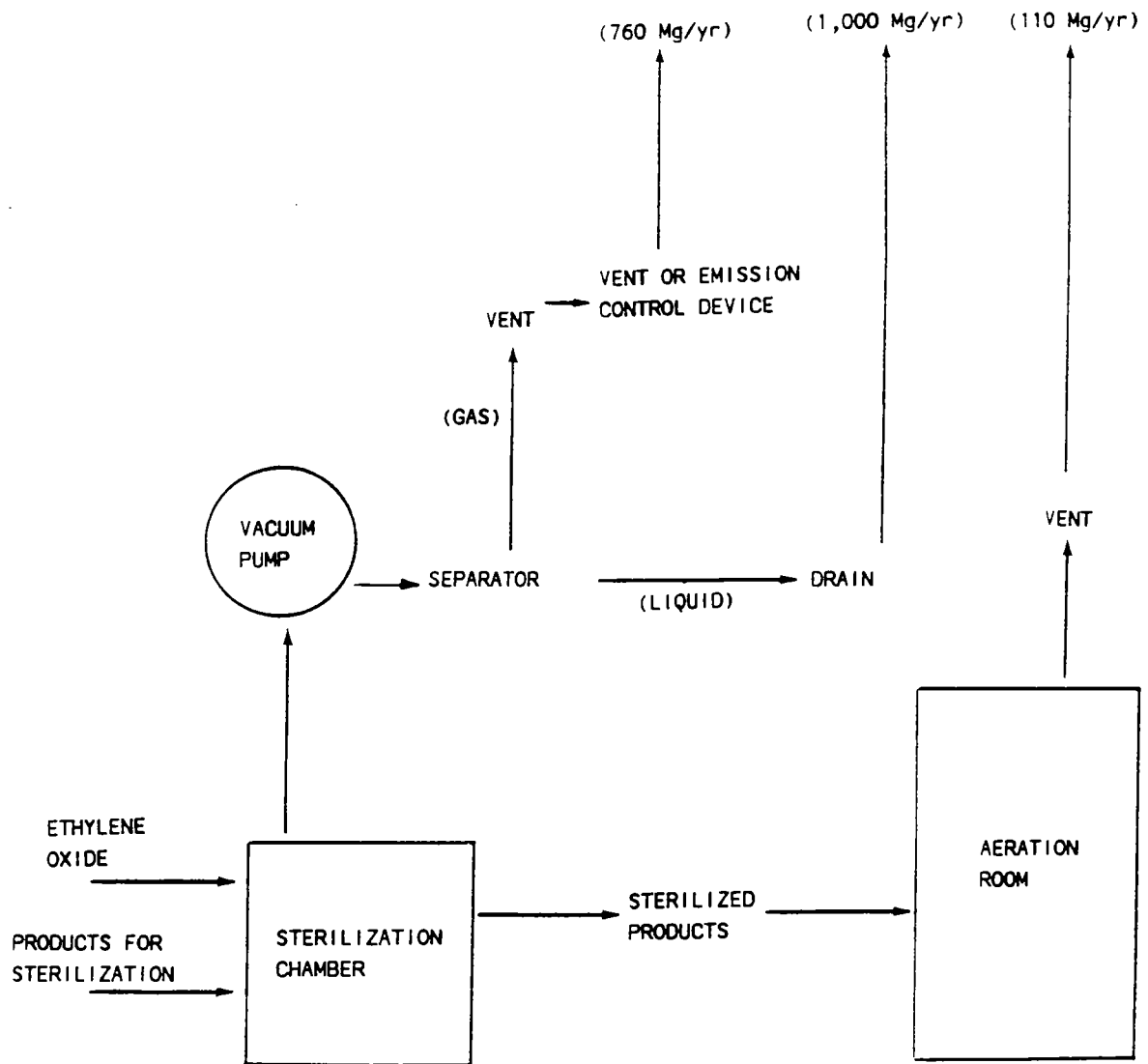


Figure 2-4. Schematic of emission sources at commercial sterilization facilities.

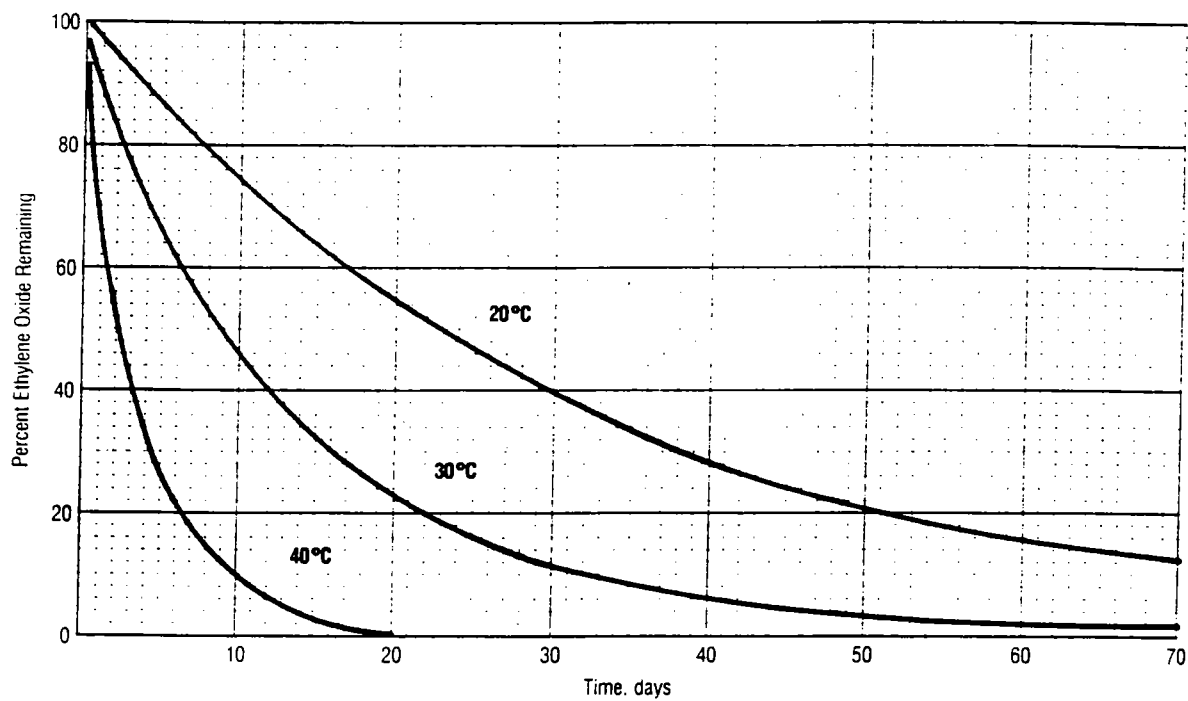


Figure 2-5. Hydrolysis rates of dilute, neutral aqueous solutions of ethylene oxide.
(Courtesy of Union Carbide Corporation, Ethylene Oxide/Glycol Division.)⁹

2.3.3 Aeration Room Vent

All emissions from residual EO are referred to as aeration room vent emissions. As residual EO diffuses out of the sterile products in the aeration room or is emitted to the sterilization room when the chamber door is opened, it is emitted to the atmosphere via room ventilation. High ventilation airflow rates are used to maintain EO concentrations below the OSHA limit.

2.3.4 Equipment Leaks

Although equipment component counts (number of flanges, elbows, etc.) were not obtained for the commercial sterilization facilities, observations made during site visits indicated that the number of components is small. Also, control of equipment leaks is important to meet the 1 ppmv OSHA standard. Consequently, equipment leak emissions are assumed to be negligible.

2.3.5 Storage and Handling

Ethylene oxide at commercial sterilization facilities is typically stored in pressurized cylinders rather than bulk containers. Therefore, material losses associated with loading and unloading bulk quantities of EO and storage tank breathing losses would not occur. Although bulk storage of sterilant gas at commercial sterilization facilities is rare, at least one facility stores bulk quantities of 12/88 in a pressure vessel. During transfer of the 12/88 from the tank truck to the pressure vessel, the vessel and the tank truck are vapor balanced. Therefore, emissions during transfer are expected to be negligible. Also, because the storage tank is a pressure vessel, no emissions should occur during routine operation. Consequently, commercial sterilization facilities are likely to have negligible storage and handling emissions.

2.4 BASELINE EMISSIONS

The baseline emission estimate represents the emission scenario as reported in the HIMA survey and EPA information request responses. The total amount of EO used by the 203 facilities in the data base is 2,270 Mg/yr, and approximately 16 percent (i.e., 370 Mg/yr) of this amount is controlled. Therefore, the baseline EO emission estimate for facilities in the commercial sterilization data base is 1,900 megagrams per year (Mg/yr).^{1,2} Of this amount, it is estimated that 760 Mg/yr are

emitted from sterilization chamber vents, 1,000 Mg/yr are emitted from sterilization chamber vacuum pump drains, and 110 Mg/yr are emitted from aeration room vents. These estimates were developed using the HIMA survey and EPA information request responses and the following assumptions:

1. All of the EO reported as used in the sterilization process is evacuated from the sterilization chamber or released from the product during aeration.
2. Within each facility, EO emissions are distributed among three emission points. The three emission points and the percentage of total EO emissions allocated to each are:
 - a. Sterilization chamber vent(s)--50 percent;
 - b. Sterilization chamber vacuum pump drain--45 percent; and
 - c. Aeration room vent(s)--5 percent.

This 50/45/5 percent split is based on industry estimates and limited test data.^{11,12}

3. For the 355 sterilization chambers in the sterilization data base that are uncontrolled, all of the EO that enters the chamber vent(s) is released to the atmosphere. For the 79 sterilization chambers with emission control devices, the chamber vent emissions are controlled at the efficiencies reported on the HIMA survey and EPA information request responses.

4. At each facility, all of the EO that dissolves in the vacuum pump water and subsequently enters the drain is assumed to be emitted uncontrolled to the atmosphere at an outdoor ground-level drain near the facility. This assumption is consistent with test data that suggest EO is rapidly released from an aqueous solution when agitated.¹⁰

5. At each facility, all of the EO that enters the aeration room vent is released uncontrolled to the atmosphere.

2.5 CURRENT REGULATIONS

The following summarizes current OSHA and State regulations for EO.

2.5.1 Occupational Safety and Health Administration Standard

In 1984, OSHA established a permissible exposure limit for occupational exposure to EO of 1 ppmv determined as an 8-hour time-weighted average (TWA) concentration. In addition, an action level of 0.5 ppmv as an 8-hour TWA was established as the level above which employers must monitor employee exposure.¹³

2.5.2 State Regulations

Existing State regulations for E0 are summarized in Table 2-6. Fifteen States are currently regulating E0. Twenty of the remaining States reported that control requirements for E0 emission sources are determined on a case-by-case basis. In addition, 18 States are developing air toxics programs.¹⁴⁻¹⁵

TABLE 2-6. STATE REGULATIONS FOR ETHYLENE OXIDE EMISSIONS¹⁴⁻¹⁵

State	Regulatory description
Colorado	<ul style="list-style-type: none"> • Regulate as a volatile organic compound (VOC). • Reasonable available control technology (RACT) required for new sources.
Connecticut	<ul style="list-style-type: none"> • Best available control technology (BACT) required for all new or modified sources exceeding a maximum allowable stack concentration (MASC). • MASC is calculated using exhaust gas flow rate, stack height, and the distance of the discharge point to the property line. MASC would be exceeded for industrial sterilizers using typical sterilization cycles. Therefore, requiring BACT on new or modified sources. Existing sources exceeding the maximum allowable ambient concentration of 0.01 ppm have 3 years to comply with orders given by the Connecticut Department of Environmental Protection.
Michigan	<ul style="list-style-type: none"> • BACT for all new sources. Requires emissions be indelectable or subjected to risk analysis. For industrial sterilizers using typical sterilization cycles a control efficiency based on a risk assessment analysis would be greater than 99 percent by weight.
Missouri	<ul style="list-style-type: none"> • Regulate as a VOC.
New Jersey	<ul style="list-style-type: none"> • Regulate as a VOC. • BACT required for new or modified sources.
New York	<ul style="list-style-type: none"> • Sources must meet the Acceptable Ambient Level (AAL) and BACT. • Assigned an "A" environmental rating, therefore requiring 99 percent emission reduction of BACT. If emissions are less than 1 lb/h (without air cleaning), BACT can be waived and other controls set (including no controls).
Oklahoma	<ul style="list-style-type: none"> • Maximum ambient air concentration at property line is 1/100 of TLV.
Puerto Rico	<ul style="list-style-type: none"> • Regulate as a VOC. • Emission controls required for emissions greater than 3 lb/h or 15 lb/d.
Rhode Island	<ul style="list-style-type: none"> • Regulate as a VOC. • BACT required for new sources if emission potential is greater than 10 lb of contaminant (i.e., both EO and CFC-12) per hour. • Developing an air toxic program. AAL at property line will be approximately 0.01 mg/m³.
Tennessee	<ul style="list-style-type: none"> • Regulate under standards for process and nonprocess emissions.
Texas	<ul style="list-style-type: none"> • BACT required for all new sources.
Utah	<ul style="list-style-type: none"> • BACT required for all new or modified sources. BACT requirements to go into effect for existing sources. • Following the programs developed in New York.
Vermont	<ul style="list-style-type: none"> • Regulate as a VOC.
Wyoming	<ul style="list-style-type: none"> • BACT required for all new sources. • Controls must meet AAL at property line.
Virginia	<ul style="list-style-type: none"> • For any 24 hour concentration exceeding 1/100 of the TLV-TWA both existing and new facilities are required to control emissions as directed by the Virginia Air Pollution Control Board.

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3. EMISSION CONTROL TECHNIQUES

3.1 BULK STERILIZATION PROCESSES

Three principal sources of ethylene oxide (EO) emissions at commercial sterilization facilities performing bulk sterilization have been identified:

1. The sterilization chamber vent;
2. The sterilization chamber vacuum pump drain; and
3. The aeration room vent.

This section presents the techniques available to control EO emissions from these three sources.

3.1.1 Sterilization Chamber Vent Emissions

The commercial sterilization industry employs the following three techniques to control EO emissions from sterilizer chamber vents: hydrolysis, oxidation, and condensation. Ethylene oxide is catalytically hydrolyzed to form ethylene glycol; oxidation decomposes EO into carbon dioxide and water; and condensation allows the recovery of the sterilant gas mixture.

Table 3-1 shows the emission control techniques and devices used by the facilities in the EPA commercial sterilization data base (refer to Chapter 2 for a description of the contents and origin of the data base). Twenty-seven of the 203 facilities (13 percent) reported the use of a control device for chamber vent emissions. Nineteen of these 27 facilities use one emission control device for multiple chambers by manifolding the chamber vents and staggering the evacuation of the sterilant gas from the chambers. The remaining eight facilities control emissions from single chambers.^{1,2}

Nine additional facilities reported the use of a neutral-water scrubber to control EO vent emissions. Neutral-water scrubbers reduce EO

TABLE 3-1. ETHYLENE OXIDE EMISSION CONTROL DEVICES FOR STERILIZATION
CHAMBER VENTS--EPA COMMERCIAL STERILIZATION DATA BASE^{1,2}

Emission control technique and device	Control efficiency, percent ^a	No. of facilities (percent)	No. of chambers (percent)	Chamber size, m ³ (ft ³)	E0 usage/facility, Mg/yr (lb/yr)
<u>Hydrolysis</u>					
Packed scrubber	96.0 - 99.9+	14 (7)	45 (10)	4-170 (140-6,000)	0.9-59 (2,000-130,000)
Reaction/detoxification tower	99.0	2 (1)	4 (1)	4-27 (140-960)	4-57 (9,500-126,000)
Caustic scrubber	30.0 and 95.0	1 (0.5)	2 (0.5)	32 and 60 (1,150 and 2,120)	44 (98,200)
<u>Oxidation</u>					
Flare	99.0 - 99.7	2 (1)	5 (1)	2-77 (60-2,720)	34 and 80 (74,200 and 176,000)
Catalytic oxidizer	99.0	1 (0.5)	1 (0.2)	4 (130)	0.4 (1,000)
<u>Condensation</u>					
Condensation/reclamation system	50.0 - 88.0	7 (3)	20 (5)	5-45 (190-1,580)	7-46 (15,000-100,800)
TOTAL		27 (13) ^b	77 (18) ^c		790 (1,750,000) ^d

^aControl efficiencies were taken from Section 114 responses provided by facilities in the EPA data base, and are not necessarily supported by EPA-sponsored test data.

^bTotal number of facilities = 203.

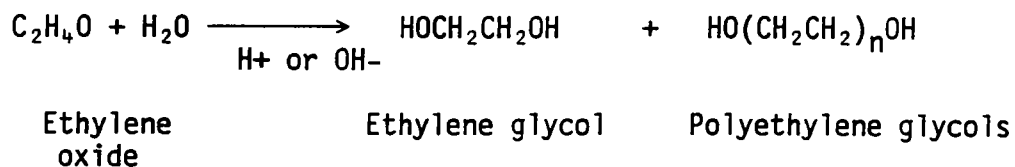
^cTotal number of chambers = 434.

^dRepresents 35 percent of the total E0 used by the 203 facilities represented in the data base.

vent emissions by "washing" a portion of the EO to the drain (facilities reported 20 to 100 percent of the total EO emissions from the sterilizer chamber were "controlled" by a neutral-water scrubber).^{1,2} Some of the EO that is washed to the drain may be converted by hydrolysis to ethylene glycol; however, the conversion rate of EO to ethylene glycol in neutral water at ambient temperatures is extremely slow, requiring weeks for completion.³ Since EO is rapidly released from an aqueous solution when agitated, the vast majority of the EO washed to the drain will offgas uncontrolled from the air break in the drain line, sewer lines, or the waste treatment system.³⁻⁵ Because the use of neutral-water scrubbers merely changes the EO emission source, they are not discussed here as a control technique.

3.1.1.1 Hydrolysis. Hydrolysis is the most common EO emission control technique used by commercial sterilization facilities.^{1,2} This technique is applicable for both pure EO and EO/inert gas mixtures such as 12/88 (12 percent by weight EO and 88 percent by weight dichlorodifluoromethane [CFC-12]) and 10/90 (10 percent by weight EO and 90 percent by weight carbon dioxide). However, the majority of commercially available hydrolysis control devices are not designed for the low flow rates associated with chamber volumes less than 1.4 m³ (50 ft³).

Ethylene oxide can be hydrolyzed under relatively mild conditions to nontoxic products (without affecting the inert gas) according to the following reaction:



Ethylene oxide will hydrolyze in neutral water, but this reaction is very slow. (The half-life of EO in neutral water at ambient temperatures is approximately 14 days.)⁵ The reaction rate is increased in an acidic or basic solution. The reaction is approximately two orders of magnitude faster under acidic conditions than under basic conditions, making acid hydrolysis the preferred method. Sixteen facilities reported using acid-water scrubbers; one facility reported using caustic scrubbers to control EO emissions.^{1,2}

3.1.1.1.1 Packed scrubbers. Figure 3-1 is a schematic of a packed scrubbing system used to control EO emissions. The system consists of a countercurrent packed tower, a reaction vessel, and a holding tank. In the countercurrent tower, the sterilant gas is contacted with an acidic water solution, generally aqueous sulfuric acid. Because EO is extremely water soluble, most of the EO is absorbed into the scrubber liquor where acid-catalyzed hydrolysis to form ethylene glycol begins. Next, the liquor is sent to the reactor vessel, which is a small storage tank operated at atmospheric pressure, to complete the hydrolysis of EO. After the reaction is complete, the liquor is sent to the storage vessel. The liquor in the storage vessel is recirculated to operate the tower until the concentration of the ethylene glycol in the liquor reaches a predetermined weight percentage, past which point the scrubber efficiency declines. Manufacturers of packed scrubbing systems suggest that the scrubbing liquor is spent when the solution is 30 to 40 percent by weight ethylene glycol.^{6,7} The spent solution is neutralized and then disposed or sold. Generally, sodium hydroxide is used to neutralize the glycol solution; sodium carbonate also can be used.

Manufacturers of countercurrent packed scrubbers designed to control EO emissions from sterilizer chamber vents claim EO removal efficiencies of greater than 99 percent.^{6,8} Countercurrent packed scrubbers are used by facilities with chambers ranging from 4.0 cubic meters (m^3) (140 cubic feet [ft^3]) to 170 m^3 (6,000 ft^3). Ethylene oxide use at these facilities ranges from 0.9 Mg/yr (2,000 lb/yr) to 59 Mg/yr (130,000 lb/yr).^{1,2}

Tests performed by independent laboratories on acid-water scrubbers support the manufacturers' claims of 99+ percent by weight removal efficiency. For a 12/88 sterilant gas mixture, the average EO removal efficiency for three tests was 99.1 percent by weight (individual test results were 99.0, 98.7, and 99.4 percent).⁹ These tests were conducted using a scrubber that was designed to achieve an EO removal efficiency of 99 percent. The manufacturer of the tested acid-water scrubber stated that they can design the scrubbers to achieve virtually any EO removal efficiency with any type of sterilant gas.¹⁰ For pure EO, the EO removal efficiency was greater than 99.98 percent for each of four tests performed at two facilities.^{9,11}

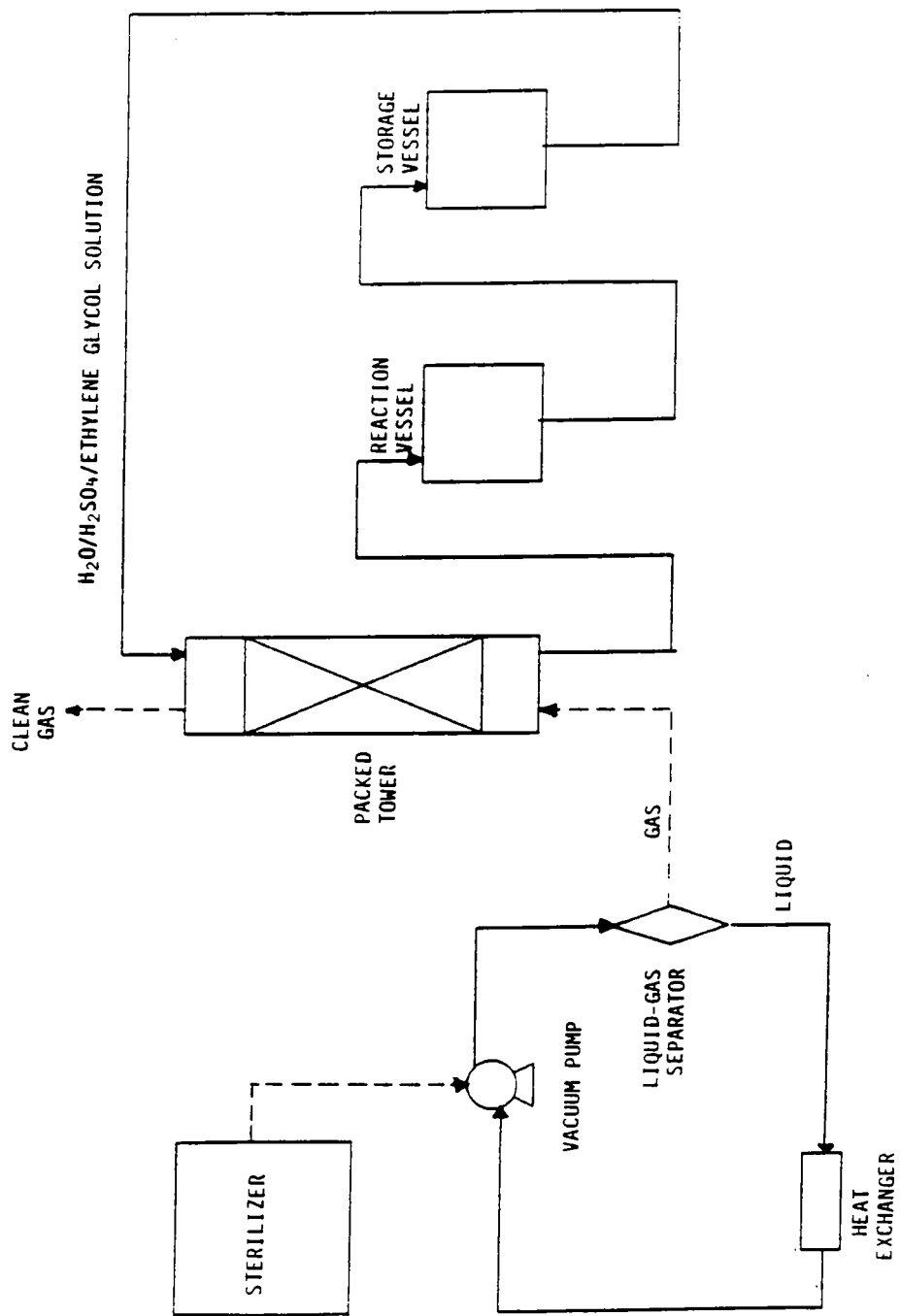
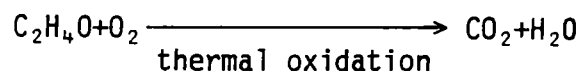


Figure 3-1. Countercurrent packed scrubbing system.

3.1.1.1.2 Reaction/detoxification towers. Another acid hydrolysis technique for EO emission control is a reaction, or detoxification, tower. A schematic of this system is shown in Figure 3-2. This system consists of a tank that holds the scrubbing liquor, which is a sulfuric acid solution at a pH of 0.5 to 2.5. The sterilant gas is bubbled upward through the liquor. The EO is absorbed into the liquor where it hydrolyzes to ethylene glycol. The gas stream then flows through the liquid surface and a demister. The demisting pad prevents acid mist from exiting with the clean gas and provides a final hydrolysis reaction site for any EO remaining in the gas stream. Inert gases (i.e., CFC-12 and CO₂) are exhausted unreacted to the atmosphere. After ethylene glycol builds up in the stream to a maximum recommended level of 60 percent, the scrubber liquor is neutralized and disposed or sold.¹² Manufacturers of this system claim 99+ percent EO removal efficiency by weight.^{13,14} Independent laboratory test results indicated that EO emission reductions greater than 99.8 percent can be achieved with detoxification towers.¹⁵ Reaction towers are effective for chambers ranging from 1.4 m³ (50 ft³) to 45 m³ (1,600 ft³).^{13,15} Two facilities represented in EPA's data base that use reaction towers to control EO emissions have chambers ranging from 4 m³ (140 ft³) to 27 m³ (960 ft³). Annual ethylene oxide use at these facilities is 4 Mg (9,500 lb) and 57 Mg (126,000 lb).^{1,2}

3.1.1.2 Oxidation. Two methods of oxidizing EO are (1) thermal oxidation with flares and (2) catalytic oxidation with a solid-phase catalyst.

3.1.1.2.1 Thermal oxidation. Ethylene oxide, which has a high heating value, a relatively low ignition temperature, and a very wide range of mixtures combustible in air (see Table 2-3), can be easily and efficiently destroyed by thermal oxidation using flares. Thermal oxidation of EO produces carbon dioxide and water as follows:



Two sterilization facilities reported using flares to control EO emissions from the use of pure EO as a sterilant gas.¹ One facility has one 76.7-m³ (2,710-ft³) chamber and uses 80 Mg (176,000 lb) of EO per

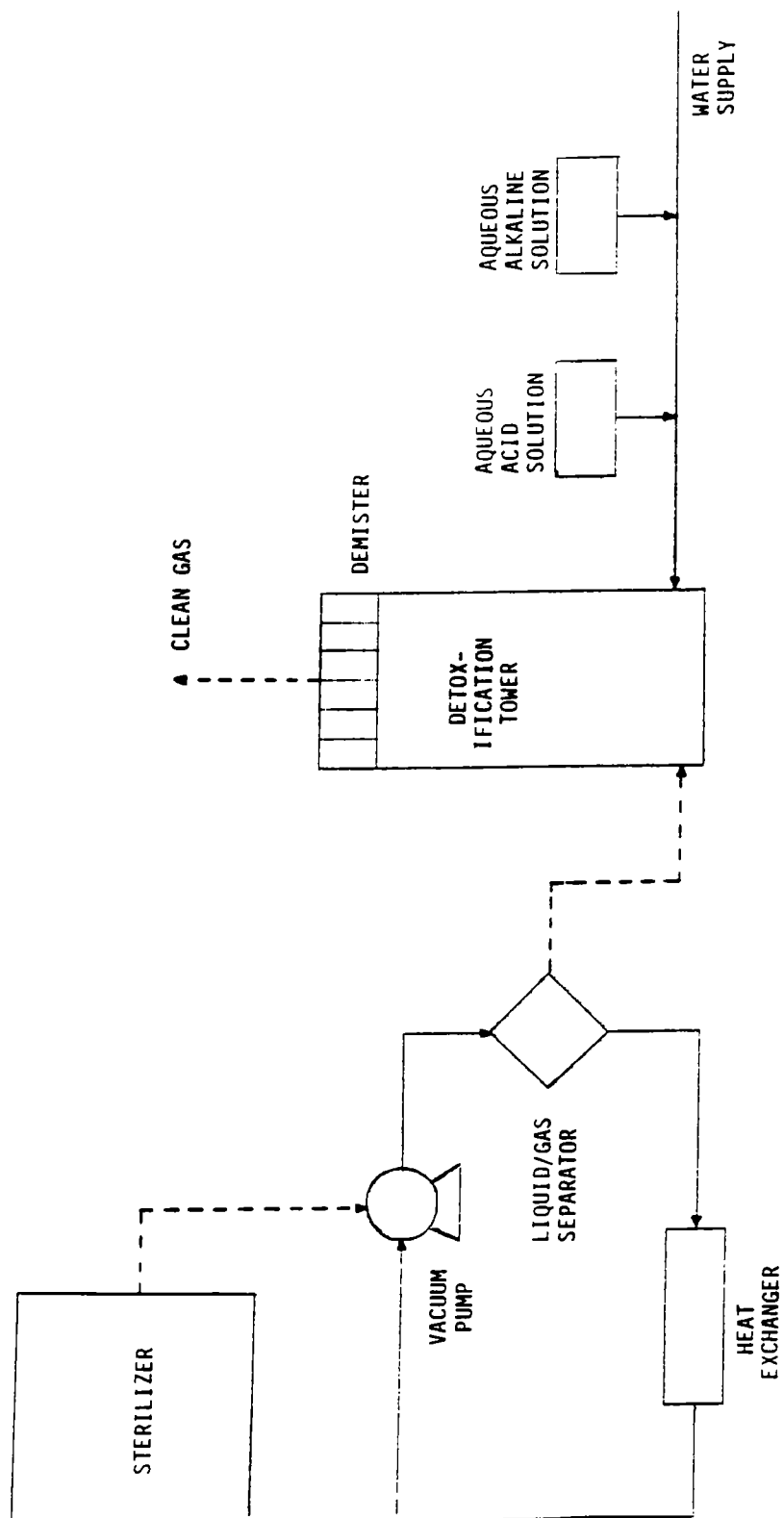
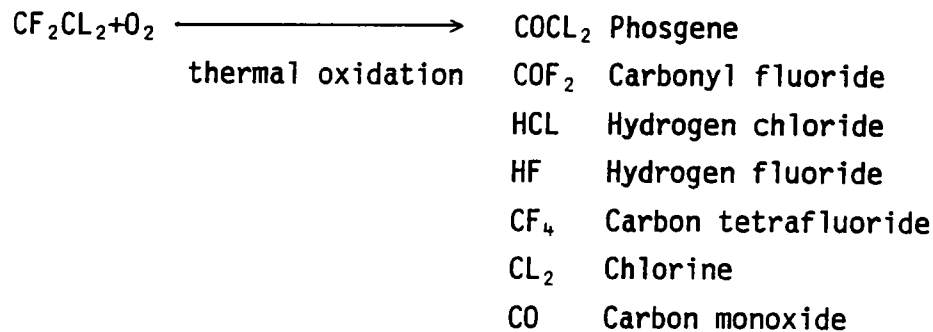
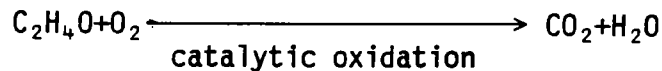


Figure 3-2. Detoxification tower control system.

year. The second facility has three chambers ranging in size from 75.2 to 76.9 m³ (2,655 to 2,715 ft³) and one smaller 1.7-m³ (60-ft³) chamber; this facility uses 98 Mg/yr (215,600 lb/yr) of EO. Because of difficulties with sustaining combustion, commercially available flares are not applicable for facilities emitting only small amounts of EO. A manufacturer of flare burners for the control of EO emissions claims greater than 99 percent control efficiency for pure EO.¹⁶ Flares can also be used with EO/CO₂ sterilant gas mixtures (e.g., 10/90) but are not designed for use with EO/CFC-12 mixtures (e.g., 12/88).^{16,17} Thermal oxidation of CFC-12 produces corrosive and toxic by-products at the high temperatures (400° to 800°C [800° to 1500°F]) associated with the use of flares as follows:¹⁶



3.1.1.2.2 Catalytic oxidation. Catalytic oxidation of EO occurs in the presence of a solid-phase catalyst as follows:



This control technique is applicable to pure EO, EO/CO₂ mixtures, and EO/CFC-12 mixtures. The CFC-12 does not react at the temperatures (150° to 180°C [300° to 350°F]) that occur during catalytic oxidation, and, therefore, the toxic CFC by-products that result from the higher temperatures associated with thermal oxidation are not produced.

A schematic of a catalytic oxidizer is shown in Figure 3-3. The spent sterilizer gas is first mixed with a large volume of air to reduce the control device inlet pollutant concentration to 5,000 ppmv or less. This dilution prevents excessive catalyst bed temperatures from occurring

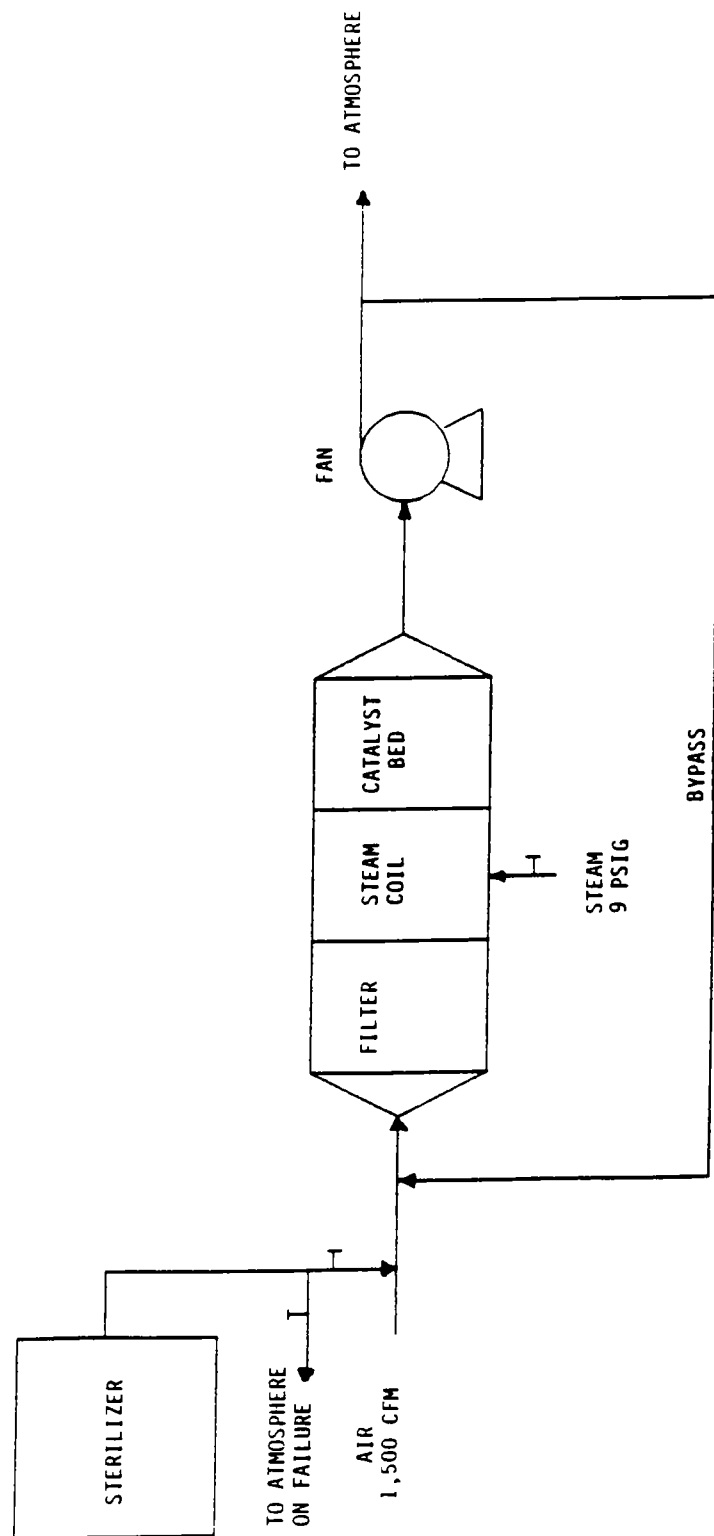


Figure 3-3. Catalytic oxidation system.

during the oxidation of EO. The gas stream passes through a filter for dust removal and then is preheated to the reaction temperature with steam or electricity. The gas then enters the catalyst bed(s) where the EO is oxidized. Part of the exiting gas stream may be recycled for heat recovery before being vented to the atmosphere.

According to one vendor, catalytic oxidizers achieve efficiencies of greater than 99 percent. Only one commercial sterilization facility reported using a catalytic oxidizer to control EO emissions from the chamber vent. This facility has one 4 m³ (130 ft³) chamber and uses 0.4 Mg/yr (1,000 lb/yr) of EO in an EO/CO₂ sterilant gas mixture.¹ Because of the large volume of dilution air required for catalytic oxidation, this technique may present problems for facilities emitting large quantities of EO.

3.1.1.3 Condensation/Reclamation Systems. Recovery of sterilant gas mixtures is possible using a reclamation system. The sterilant gas mixtures will condense under conditions of reduced temperature and increased pressure, but precautions are necessary to avoid explosions.

Figure 3-4 is a schematic of a sterilization chamber room and reclamation system for a 12/88 sterilant gas mixture. (See Table 2-3 for physical and chemical properties of CFC-12.) After each sterilization cycle, the 12/88 gas is withdrawn and passed through one of the two desiccant beds next to the chamber. (One of the desiccant beds is regenerated while the other is in use.) The dried 12/88 gas then passes to a compressor where it is compressed to 50 psig to improve condensation efficiency. The compressed gas is piped to a separate explosion-proof room where it passes through a pressurized condenser that is chilled by ethylene glycol to about -18°C (0°F). The liquid 12/88 mixture is collected in a pressurized, chilled holding tank. The uncondensed gas is recirculated to the chamber and back through the condenser. The closed-loop, recirculation cycle continues for 60 to 90 minutes. After the reclamation cycle is complete, the remaining gas in the chamber is vented to the roof and released uncontrolled to the atmosphere.¹⁸

The liquid collected in the holding tank is transferred to a pressurized reblending tank where the liquid is mixed and its composition determined by infrared analysis. The liquid is then adjusted to the

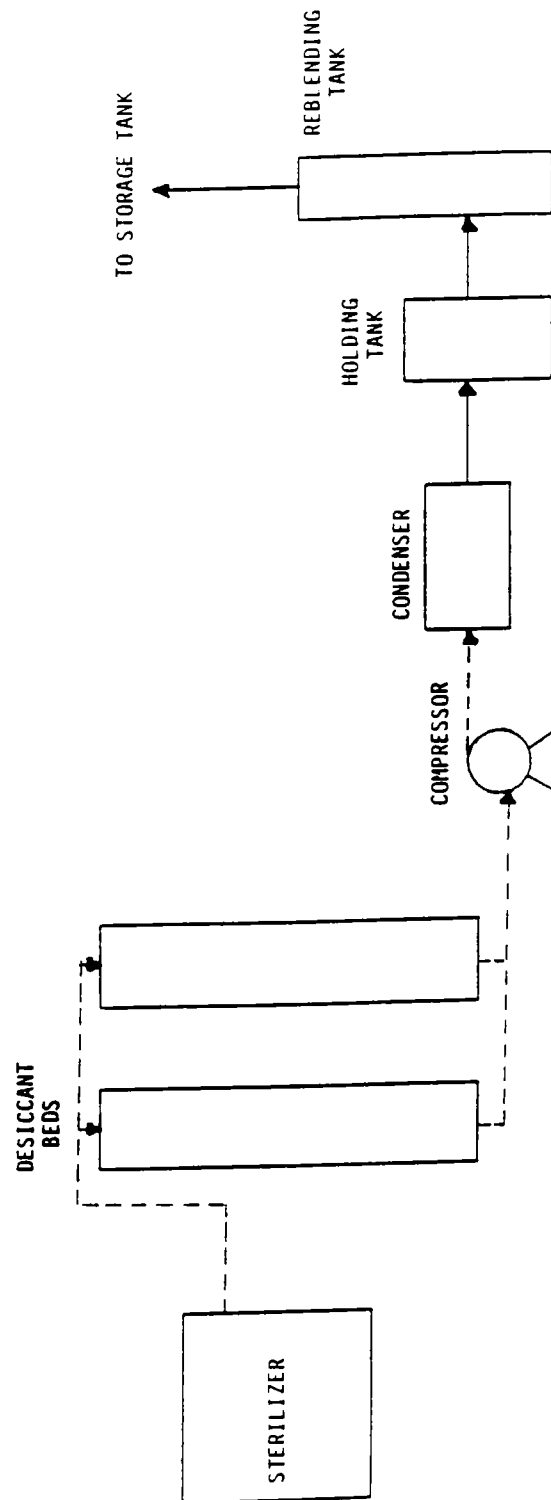


Figure 3-4. Condensation/reclamation system.

12/88 (weight percent) ratio by adding the necessary amount of EO or CFC-12. When the correct ratio is obtained, the liquid is transferred to a pressurized storage tank in the chamber room.¹⁸

Seven facilities reported using reclamation systems; three of these facilities reported an 85 percent EO recovery efficiency, three reported 80 percent, and one reported 50 percent. These seven facilities recover EO/CO₂ and EO/CFC-12 sterilant gases. Six of these facilities each use over 23 Mg/yr (50,000 lb/yr) of EO. The seventh facility uses just over 6.8 Mg/yr (15,000 lb/yr).^{1,2} The chamber sizes range from 5 to 45 m³ (190 to 1,580 ft³) at these seven facilities.^{1,2}

3.1.2 Sterilization Chamber Vacuum Pump Drain Emissions

Ethylene oxide drain emissions result from the use of vacuum pumps that use once-through water as the working fluid. Ethylene oxide is infinitely soluble in water, and, therefore, a portion (assumed to be 45 percent of the EO charged to the chamber; see Section 2.4 for the basis of this assumption) of the EO evacuated from the chamber enters the drain with the vacuum pump water (see Figure 3-5a). The EO that enters the drain with the vacuum pump water is subsequently released uncontrolled from the air break in the drain line, sewer lines, or the waste treatment plant.³⁻⁵

The EO drain emissions can be controlled by replacing the existing once-through vacuum pump with a closed-loop (recirculating) vacuum pump. The recirculating fluid (sealant) can be water, oil or ethylene glycol.¹⁹ In this closed-loop system, the water or liquid from the liquid-gas separator is cooled in a heat exchanger and recirculated through the vacuum pump (see Figure 3-5b). Because ethylene oxide is not soluble in oil or ethylene glycol and will offgas from water as it is recirculated, nearly all of the EO will be emitted through the liquid-gas separator (chamber) vent. (Techniques for control of chamber vent emissions are discussed above.) In addition, mechanical seals are used to eliminate liquid leakage (and thus, any EO emissions) from the pump.²⁰

Because the sterilization cycle operates under humid conditions, some water will be condensed in the liquid-gas separator, and thus, mix with the liquid sealant in the pump. An overflow collection tank is used to maintain a constant amount of sealant recirculating in the pump.²⁰ If

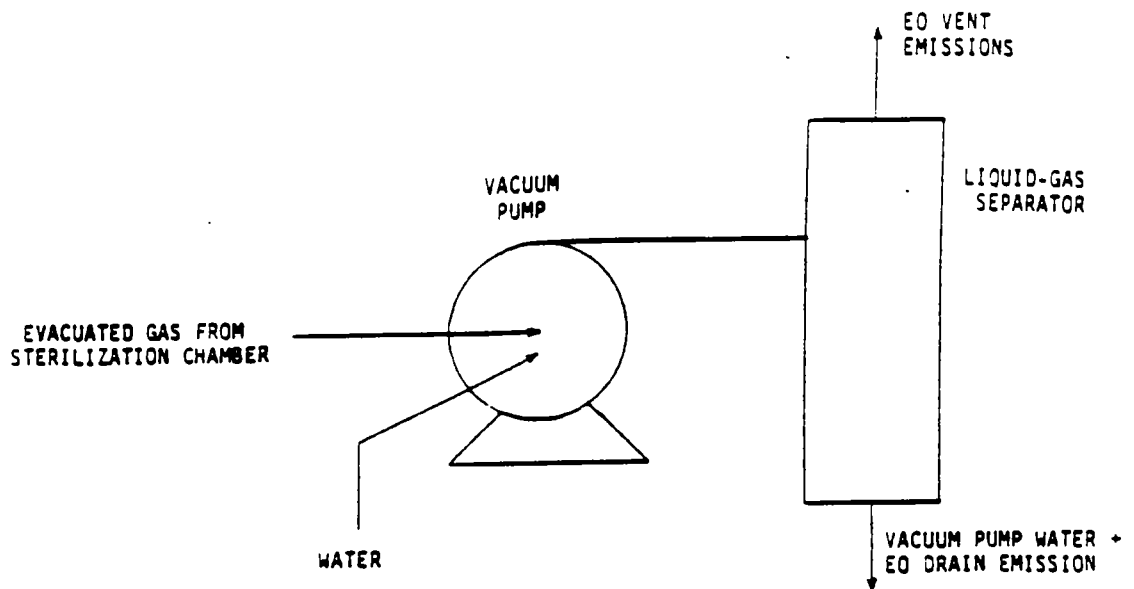


Figure 3-5a. Once-through liquid-ring vacuum pump.

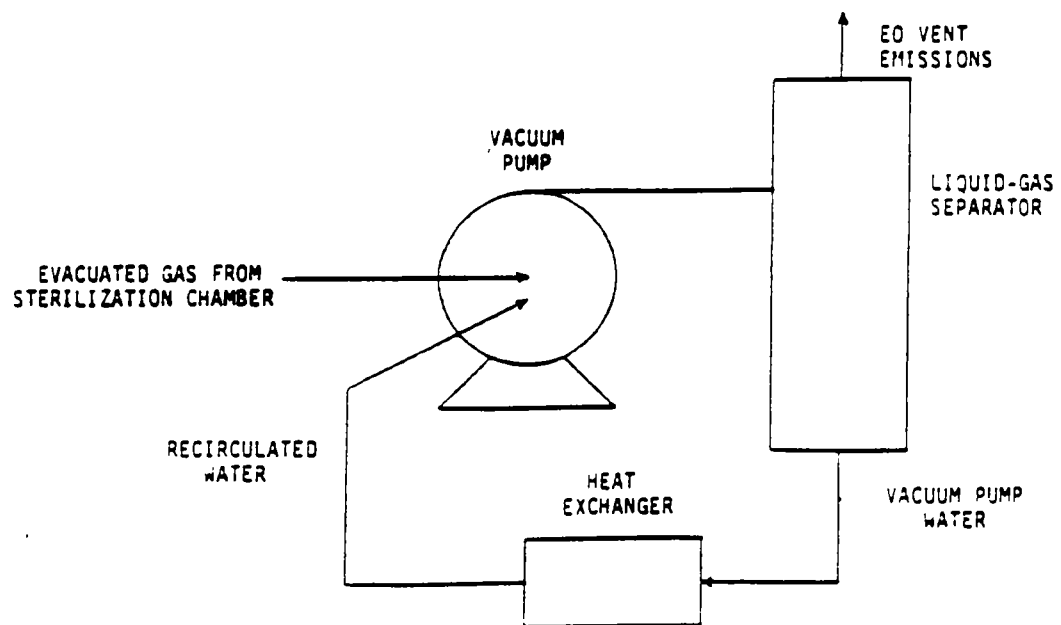


Figure 3-5b. Recirculating liquid-ring vacuum pump.

ethylene glycol is used as the sealant, the contaminated glycol will eventually need to be disposed and replaced with a fresh charge.¹⁹ However, if oil is used as the sealant, the condensed water can be drained off the bottom with minimal oil loss because of the immiscibility of oil and water.¹⁹

3.1.3 Aeration Room Vent Emissions

Catalytic oxidation is the only control technology that has the potential to control the low-concentration gas streams from aeration rooms. As discussed previously, catalytic oxidation requires an inlet EO concentration below 5,000 ppmv. Therefore, under particular conditions, aeration room emissions may be controlled. Hydrolysis, thermal oxidation, and condensation/reclamation are not practicable alternatives because of the typically low-concentration, high-volumetric-flow-rate gas streams from aeration room vents.

Three commercial sterilization facilities use catalytic oxidizers to reduce EO emissions from aeration rooms.^{1,2} The effectiveness of using catalytic oxidation to control aeration room emissions is unknown. One facility uses a small chamber (4 m³ [130 ft³]) and has an aeration chamber instead of an aeration room. In this instance, both the sterilization chamber and aeration chamber vents are ducted to the catalytic oxidizer. The gas stream from the aeration chamber is used as dilution air to reduce the EO concentration in the sterilization chamber gas stream to below 5,000 ppmv. The other two facilities sterilize synthetic rubber products, which retain a large amount of residual EO and, therefore, produce higher EO concentrations than are typically found in commercial sterilization aeration rooms.² Catalytic oxidation is used by these facilities to comply with the OSHA standard.

Another strategy for reducing aeration room emissions is modifying the evacuation phase of the sterilization cycle. Residual EO in the product can be reduced by performing additional chamber purges. The potential reduction in residual EO with evacuation-phase modifications is product dependent. Test results performed at one facility that fumigates spices showed an average reduction in residual EO of 26 percent for four different spices following evacuation-phase modifications.¹¹

3.2 OTHER STERILIZATION PROCESSES

There are no demonstrated control devices for commercial sterilization facilities that use processes other than bulk sterilization. The following discusses the problems with controlling EO emissions from the alternate processes, single-item sterilization, and fumigation with portable units.

3.2.1 Single-item Sterilization

Single-item sterilization systems do not use a chamber evacuated with a vacuum pump. (See Section 2.2.2 for a description of single-item sterilization.) Instead, the EO is allowed to diffuse from products while they are inside an aeration room or cabinet. The EO from facilities using single-item sterilization systems are, therefore, emitted from one major source, the aeration room/cabinet vent. The problems discussed above regarding the control of low-concentration and high volumetric flow rates exist in this case. Because there is no evacuation phase, the EO concentration in the gas stream from single-item sterilization systems would be higher than the concentration of EO in the aeration room gas stream from a commercial sterilization facility that uses chamber evacuation; however, the concentration is sufficiently low such that catalytic oxidation may be considered a viable control. Therefore, emission controls, such as a catalytic oxidizer, may be applicable.

3.2.2 Fumigation with Portable Units

Because of problems with transporting an emission control device, there are no practical controls of EO emissions from the portable units operated by State departments of agriculture to fumigate beehives. However, one State Department of Agriculture is working on the development of an acid-water scrubber for portable fumigation units.²

3.3 ALTERNATIVES TO EO STERILIZATION

In some cases, radiation sterilization can replace EO sterilization. Radiation sterilization is used for about half of the products sterilized in the U.S.²¹ However, not all products can be sterilized with radiation; plastics can become broken, discolored, or malodorous, and Teflon® and acetyl delrin are damaged by radiation.^{21,22}

Other alternatives to EO sterilization include sterilization with propylene oxide or formaldehyde. In some cases, it may be possible to

develop products that can withstand the high temperatures and humidity of steam sterilization (e.g., autoclaves) to replace products currently sterilized with EO.

3.4 RETROFIT CONSIDERATIONS

All of the control devices discussed above can be retrofitted to existing EO bulk sterilization chambers. However, the use of flares in urban areas is prohibited because of safety hazards. There are no retrofit problems associated with the replacement of once-through vacuum pumps with closed-loop recirculating vacuum pumps for control of drain emissions.

3.5 IMPACTS OF A CFC REGULATION ON EO EMISSION CONTROLS

Federal regulations for stratospheric ozone-depleting chlorofluorocarbons (CFC's) are being considered under EPA's Stratospheric Ozone Protection Program (SOPP). The commercial sterilization industry is one of the source categories that could possibly be subject to these regulations. Dichlorodifluoromethane (CFC-12), which is an ozone-depleting CFC, makes up 88 percent (by weight) of the sterilant gas mixture used by 75 percent of the commercial sterilization facilities.^{1,2} The requirements of a CFC regulation would not affect the ability of a commercial sterilization facility to control EO emissions. The explosion-proof condensation/reclamation system discussed above recovers CFC-12 emissions. Also, a nonexplosion-proof condensation/reclamation system that recovers only CFC-12 could follow the acid-water scrubbing of EO to ethylene glycol. This two-step control technique allows for a higher control efficiency for EO emissions than the explosion-proof condensation/reclamation system that recovers both EO and CFC-12. If CFC regulations are implemented, some facilities may switch to sterilant gases that do not contain CFC-12 (such as 10/90 and pure EO), in which case, the EO control techniques discussed above would be applicable.

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11. Desai, P. Performance Test Report: DEOXX™ Ethylene Oxide Detoxification System. Chemrox Project No. 85-260. October 1985.
12. Memorandum from Srebro, S., MRI, to Markwordt, D., EPA:CPB. Capital cost, annualized cost, and cost effectiveness of reducing ethylene oxide emissions at commercial sterilization facilities. March 20, 1987. 80 p.
13. Product Data Sheet. Environmental Tectonics Corporation. Enclosure to letter from Peters, J., Environmental Tectonics Corporation, to Nicholson, B., MRI, June 10, 1987.
14. Meeting Minutes. Beall, C., MRI, to Markwordt, D., EPA:CPB. Damas Corp. and Johnson & Johnson. April 30, 1986. 9 p.
15. Letter and attachments from Smith, D., Damas Corp., to Wyatt, S., EPA:CPB. September 21, 1987. Comments on draft BID Chapter 4 for ethylene oxide NESHAP.
16. Letter and attachments from Smith, S., John Zink Company, to Coronna, B., MRI. October 3, 1986. Information about the John Zink EO flare.

17. Telecon. Soltis, V., MRI, with Duck, B., John Zink Company. July 8, 1987. Discussion about EO sterilant gas mixtures and the use of flares.
18. Memorandum. Beall, C., MRI, to Markwordt, D., EPA:CPB. Trip Report: Sterilization Services of Tennessee, Memphis, Tennessee, on March 18, 1986.
19. Buonicore, A. In-Plant Programs to Reduce Ethylene Oxide Worker Exposure Levels. Chemrox, Inc., Bridgeport, Connecticut. August 1984.
20. EO-VAC™ Closed Loop Vacuum Product Information Sheet. Chemrox, Inc., Bridgeport, Connecticut. May 1987.
21. Telecon. Soltis V., MRI, with Jorkasky, J., Health Industry Manufacturers Association. March 2, 1987. Discussion about trends in the sterilization industry.
22. Telecon. Beall, C., MRI, with Chin, A., Radiation Sterilizers, Inc. February 22, 1986. Discussion about gamma radiation.

4. MODIFICATIONS

4.1 BACKGROUND

The purpose of this chapter is to discuss possible modifications to sources of ethylene oxide (EO) emissions at commercial sterilization facilities. A national emission standard for hazardous air pollutants (NESHAP) is applicable to both existing and new sources. A "new source" is defined under the Code of Federal Regulations, Title 40, Section 61.02 (40 CFR 61.02) as one on which construction or modification begins after the proposal date of the applicable NESHAP. Any stationary source that is not a new source is considered an existing source.¹ This distinction is important because a new source must comply with the applicable NESHAP at startup, while an existing source must comply within 90 days after the effective date of the standard.² However, the owner or operator of an existing source may apply to the EPA Administrator within 90 days of the effective date for a waiver of compliance. The waiver period, if granted, may not exceed 2 years after the effective date of the standard.³

An owner or operator of an existing source who plans to modify that source must apply to the Administrator of the U. S. Environmental Protection Agency (EPA) for approval prior to starting the modification.⁴ A "modification" is defined under 40 CFR 61.15 as "any physical or operational change to a stationary source which results in an increase in the rate of emission to the atmosphere of a hazardous pollutant to which a standard applies."⁵ The following are not considered modifications for EO sterilization facilities:

1. Maintenance, repair, and replacement which the Administrator determines to be routine for a source category;
2. An increase in production rate of a stationary source, if that increase can be accomplished without a capital expenditure on the stationary source;

3. An increase in the hours of operation; and
4. The relocation or change in ownership of a stationary source.⁵

The EPA Administrator determines whether a physical or operational change to a source constitutes a modification.⁶ An existing source that is modified is subsequently considered a new source for the applicable hazardous air pollutant and, therefore, must immediately comply with the applicable NESHAP.^{2,5}

4.2 POSSIBLE MODIFICATIONS

Sterilization with EO is a straightforward process that involves minimal equipment (see Chapter 2). Therefore, the number of possible process or equipment modifications that could be made at an existing commercial sterilization facility is limited.

4.2.1 Process Modifications

No process modifications are anticipated that would result in a facility being subject to the modification provisions. For example, an operational change such as an increase in EO use at a facility due to an increase in the amount of EO used per cycle would be unlikely to require a capital expenditure. As mentioned earlier, this change would not be a modification if the increased production rate could be accomplished without a capital expenditure on the stationary source (i.e., the sterilization chamber).⁵ "Capital expenditure" is defined under 40 CFR 61.02 as

an expenditure for a physical or operational change to a stationary source which exceeds the product of the applicable 'annual asset guideline repair allowance percentage' specified in the latest edition of Internal Revenue Service (IRS) Publication 534 and the stationary source's basis, as defined by Section 1012 of the Internal Revenue Code.

It is also unlikely that a change in product types to be sterilized would result in the facility being subject to the modification provisions because no physical or operational changes to the sterilizer would be required. The chambers are designed initially to handle any product type.

4.2.2 Equipment Modifications

If the source is defined as the entire sterilizer facility, then the addition or replacement of a sterilizer chamber could be considered an equipment modification. If this change results in an increase in EO

emissions and if the cost of this change qualifies as a capital expenditure, then the change may be considered a modification.

Discontinuing the use of a control device or a control technique may be considered a modification if the associated increase in emissions is not eliminated by an alternate control technology. For example, if a facility using an oil-sealed vacuum pump, which eliminates EO vacuum pump drain emissions, replaces the pump with a once-through water-sealed pump, the change would be considered a modification unless a closed-loop recirculation system was installed on the water-sealed pump (i.e., an alternate technique to control drain emissions).

4.3 REFERENCES FOR CHAPTER 4

1. U. S. Environmental Protection Agency. Code of Federal Regulations. Title 40, Chapter I, Subchapter C, Part 61, Section 61.02. Office of Federal Register, Washington, D.C. July 1, 1987.
2. Reference 1, Section 61.05.
3. Reference 1, Section 61.10.
4. Reference 1, Section 61.07.
5. Reference 1, Section 61.15.
6. Reference 1, Section 61.06.

5. PLANT PARAMETERS AND REGULATORY OPTIONS

5.1 INTRODUCTION

5.1.1 Overview

Data in the EPA commercial sterilization data base were obtained from a 1985 survey of medical equipment suppliers conducted by the Health Industry Manufacturers' Association (HIMA) and from responses to a 1986 EPA information request submitted to miscellaneous sterilizers and fumigators under Section 114 of the Clean Air Act. The 203 facilities (434 chambers) that comprise the data base are located in 43 States and Puerto Rico (see Table 2-1, Chapter 2). These facilities are grouped by Standard Industrial Classification (SIC) code into the following categories:

1. Medical equipment suppliers;
2. Pharmaceuticals;
3. Other health-related industries;
4. Spice manufacturers;
5. Contract sterilizers;
6. Libraries, museums, and archives;
7. Laboratories (research, testing, and animal breeding); and
8. State departments of agriculture.

The data base includes information on the number of chambers, chamber size, sterilant gas type, total annual sterilant gas throughput, annual EO use, and level of emission control. Of the 203 facilities that comprise the data base, only 191 (419 of the 434 chambers) were considered in the development of regulatory options and cost analyses. Facilities using single-item sterilization (Sterijet®) units and beehive fumigators used by State agriculture departments were not included in the regulatory/cost analyses because there are no demonstrated control technologies for facilities using these sterilization processes (see Chapter 3, Section 3.2).

5.1.2 Baseline Controls

Baseline control at a particular facility is defined as the level of control reported by that facility in the HIMA survey or EPA information request response. For the 355 uncontrolled chambers represented in the EPA data base, all of the EO that enters the chamber is assumed to be released to the atmosphere via the chamber vent, the vacuum pump drain, and the aeration room vents. For the 79 sterilization chambers with emission control devices, the chamber vent emissions are assumed to be controlled at the efficiencies reported in the HIMA survey or EPA information request responses. Chamber vacuum pump drain and aeration room emissions are assumed to be uncontrolled.

For the purpose of evaluating facility-specific control costs, four baseline categories were considered: facilities with existing oxidation control devices, facilities with existing acid-water scrubbers, facilities with low-efficiency control devices (e.g., condensation/reclamation systems, caustic scrubbers), and uncontrolled facilities. These baseline categories and the methodologies by which the costs associated with each were developed are discussed in detail in Chapter 7.

5.2 REGULATORY ANALYSES

To evaluate the effects of regulating commercial sterilization facilities, cutoff levels were established for exclusion of facilities from regulation. These cutoff levels are based on a facility's total chamber volume and annual EO use. Any facility with a total chamber volume or EO use rate greater than or equal to the chamber volume or EO use rate for a particular cutoff level would be subject to regulation. Only one level of control was considered; the impacts associated with regulating commercial sterilizers were analyzed for each cutoff level. Estimates for emission rates and the costs of regulatory compliance are based on the following control technology: EO emissions from the chamber vent would be controlled by an acid-water scrubber, and vacuum pump drain emissions would be controlled by replacing the once-through water-sealed vacuum pump with a vacuum pump that has a closed-loop recirculation system. Facilities with existing oxidation control devices (e.g., flares, catalytic oxidation units) would achieve regulatory compliance by installing a recirculating vacuum pump(s) to control drain emissions. All

E0 entering the vacuum pump would be routed to the control device through the chamber vent rather than being split between the vent and drain, thus eliminating E0 emissions from the drain. The control technologies considered in the regulatory analyses are assumed to provide control of vent and drain emissions at the maximum achievable level (i.e., 98 percent for flares, 99 percent for acid/water scrubbers and catalytic oxidation units). Aeration room emissions are assumed to be uncontrolled.

Baseline emission estimates have been developed for each facility based on the E0 use and the level of control reported from the HIMA survey and EPA information request responses. The environmental impacts (i.e., potential emission reduction, waste disposal impacts) were estimated for each facility based on the level of control discussed above. The methodologies for assessing nationwide environmental impacts are presented in Chapter 6. Facility-specific capital and annualized costs were also developed for the implementation of the control technologies discussed above. The methodologies for estimating plant-specific and nationwide cost impacts are discussed in Chapter 7. A tabular summary of the estimated environmental and cost impacts associated with the various cutoff levels is presented in a separate document, entitled: "Supplement to the Commercial Sterilization BID--Environmental and Cost Impacts Associated with Regulatory Compliance."

Tables 5-1a and 5-1b present the chamber sizes and E0 use rates that comprise the 82 cutoff levels as well as the estimated nationwide emissions associated with each level. Under cutoff No. 1, no facility would be exempted from regulation. Cutoff No. 81, however, would allow the exclusion of all facilities using less than 18,160 kilograms of E0 per year (kg/yr) (40,000 pounds per year [lb/yr]) and having a total chamber volume less than 28.3 cubic meters (m^3) (1,000 cubic feet [ft^3]). Total E0 emissions for all facilities that would be subject to regulation at each cutoff level were determined by summing the amount of E0 emitted by each of the facilities with a total chamber size or E0 use rate greater than or equal to the chamber size and E0 use rate defined by that particular cutoff.

TABLE 5-1a. TOTAL CHAMBER SIZE AND
EO USE CUTOFF LEVELS FOR COMMERCIAL
STERILIZATION REGULATORY ANALYSES
(metric units)

Cutoff level	Total chamber size cutoff, cubic meters	EO use cutoff, Mg/yr	EO emissions from facilities above the cutoff, Mg/yr
1	0.00	0.00	1887
2	2.83	2.27	1881
3	2.83	4.54	1881
4	2.83	6.81	1881
5	2.83	9.08	1881
6	2.83	11.35	1881
7	2.83	13.62	1881
8	2.83	15.89	1881
9	2.83	18.16	1881
10	5.66	2.27	1875
11	5.66	4.54	1873
12	5.66	6.81	1873
13	5.66	9.08	1873
14	5.66	11.35	1873
15	5.66	13.62	1873
16	5.66	15.89	1873
17	5.66	18.16	1873
18	8.50	2.27	1867
19	8.50	4.54	1857
20	8.50	6.81	1852
21	8.50	9.08	1852
22	8.50	11.35	1852
23	8.50	13.62	1852
24	8.50	15.89	1852
25	8.50	18.16	1852
26	11.33	2.27	1865
27	11.33	4.54	1847
28	11.33	6.81	1840
29	11.33	9.08	1840
30	11.33	11.35	1840
31	11.33	13.62	1840
32	11.33	15.89	1840
33	11.33	18.16	1840
34	14.16	2.27	1860
35	14.16	4.54	1837
36	14.16	6.81	1825
37	14.16	9.08	1825
38	14.16	11.35	1825
39	14.16	13.62	1825
40	14.16	15.89	1825
41	14.16	18.16	1825
42	16.99	2.27	1852
43	16.99	4.54	1820
44	16.99	6.81	1798
45	16.99	9.08	1790

TABLE 5-1a. TOTAL CHAMBER SIZE AND
EO USE CUTOFF LEVELS FOR COMMERCIAL
STERILIZATION REGULATORY ANALYSES
(metric units)

Cutoff level	Total chamber size cutoff, cubic meters	EO use cutoff, Mg/yr	EO emissions from facilities above the cutoff, Mg/yr
46	16.99	11.35	1790
47	16.99	13.62	1790
48	16.99	15.89	1790
49	16.99	18.16	1790
50	19.82	2.27	1847
51	19.82	4.54	1806
52	19.82	6.81	1772
53	19.82	9.08	1756
54	19.82	11.35	1747
55	19.82	13.62	1747
56	19.82	15.89	1747
57	19.82	18.16	1747
58	22.65	2.27	1844
59	22.65	4.54	1803
60	22.65	6.81	1769
61	22.65	9.08	1753
62	22.65	11.35	1744
63	22.65	13.62	1744
64	22.65	15.89	1744
65	22.65	18.16	1744
66	25.49	2.27	1844
67	25.49	4.54	1799
68	25.49	6.81	1759
69	25.49	9.08	1735
70	25.49	11.35	1726
71	25.49	13.62	1726
72	25.49	15.89	1726
73	25.49	18.16	1726
74	28.32	2.27	1844
75	28.32	4.54	1799
76	28.32	6.81	1759
77	28.32	9.08	1735
78	28.32	11.35	1726
79	28.32	13.62	1726
80	28.32	15.89	1726
81	28.32	18.16	1710
82	BASELINE		1887

TABLE 5-1b. TOTAL CHAMBER SIZE AND
EO USE CUTOFF LEVELS FOR COMMERCIAL
STERILIZATION REGULATORY ANALYSES
(English units)

Cutoff level	Total chamber size cutoff, cubic feet	EO use cutoff, lb/yr	EO emissions from facilities above the cutoff, tons/yr
1	0	0	2079
2	100	5000	2072
3	100	10000	2072
4	100	15000	2072
5	100	20000	2072
6	100	25000	2072
7	100	30000	2072
8	100	35000	2072
9	100	40000	2072
10	200	5000	2065
11	200	10000	2062
12	200	15000	2062
13	200	20000	2062
14	200	25000	2062
15	200	30000	2062
16	200	35000	2062
17	200	40000	2062
18	300	5000	2056
19	300	10000	2045
20	300	15000	2039
21	300	20000	2039
22	300	25000	2039
23	300	30000	2039
24	300	35000	2039
25	300	40000	2039
26	400	5000	2054
27	400	10000	2034
28	400	15000	2026
29	400	20000	2026
30	400	25000	2026
31	400	30000	2026
32	400	35000	2026
33	400	40000	2026
34	500	5000	2049
35	500	10000	2024
36	500	15000	2010
37	500	20000	2010
38	500	25000	2010
39	500	30000	2010
40	500	35000	2010
41	500	40000	2010
42	600	5000	2040
43	600	10000	2005
44	600	15000	1981
45	600	20000	1971

TABLE 5-1b. TOTAL CHAMBER SIZE AND
EO USE CUTOFF LEVELS FOR COMMERCIAL
STERILIZATION REGULATORY ANALYSES
(English units)

Cutoff level	Total chamber size cutoff, cubic feet	EO use cutoff, lb/yr	EO emissions from facilities above the cutoff, tons/yr
46	600	25000	1971
47	600	30000	1971
48	600	35000	1971
49	600	40000	1971
50	700	5000	2034
51	700	10000	1989
52	700	15000	1952
53	700	20000	1934
54	700	25000	1924
55	700	30000	1924
56	700	35000	1924
57	700	40000	1924
58	800	5000	2031
59	800	10000	1985
60	800	15000	1948
61	800	20000	1931
62	800	25000	1920
63	800	30000	1920
64	800	35000	1920
65	800	40000	1920
66	900	5000	2031
67	900	10000	1982
68	900	15000	1937
69	900	20000	1911
70	900	25000	1900
71	900	30000	1900
72	900	35000	1900
73	900	40000	1900
74	1000	5000	2031
75	1000	10000	1982
76	1000	15000	1937
77	1000	20000	1911
78	1000	25000	1900
79	1000	30000	1900
80	1000	35000	1900
81	1000	40000	1883
82	BASELINE		2079

6. ENVIRONMENTAL IMPACTS

This section presents the methodology for estimating the environmental impacts associated with each of the cutoff levels discussed on Chapter 5 with respect to both primary and secondary impacts on air, water, solid waste, and energy resulting from the use of EO emission control systems. Both beneficial and adverse impacts are assessed for each of the 191 facilities that were considered in the development of the regulatory and control cost analyses. The 82 cutoff levels presented in Chapter 5 are based on total chamber volume and EO use. Potential emission and risk reductions were developed for the various cutoff levels using the facility-specific data in the EPA commercial sterilization database. Because no significant growth is expected for this industry, the 5-year impacts are the same as current impacts, and, therefore, only current impacts are presented in this section.¹

6.1 AIR POLLUTION IMPACTS

6.1.1 Baseline Emissions and Emission Reduction

Nationwide baseline EO emissions were calculated by summing the amount of EO emitted by each of the facilities at their current level of control. The potential emission reductions associated with each cutoff level were evaluated by summing the plant-specific emission reductions for facilities that would be subject to regulation at that particular cutoff. Potential emission reductions were estimated based on the assumption that the control technologies considered (or existing) for each facility would provide control of chamber vent and vacuum pump drain emissions at the maximum achievable level (i.e., 98 percent for flares, 99 percent for acid/water scrubbers and catalytic oxidation units). Aeration room emissions are assumed to be uncontrolled. Estimated potential emission reductions, nationwide residual emissions after

regulatory compliance, and percent emission reductions for each cutoff level are presented in the "Supplement to the Commercial Sterilization BID--Environmental and Cost Impacts Associated With Regulatory Compliance."

6.1.2 Results of Dispersion Modeling

As part of the air pollution impact study, a dispersion modeling analysis of the emissions under each of the regulatory options was conducted. An explanation of the modeling approach is provided in Appendix C. Also included in this appendix is a brief discussion regarding modeling of short-term concentrations of E0. The facility-specific dispersion modeling results were used to estimate the annual incidence (number of cancer deaths per year due to E0 exposure) associated with each of the cutoff levels. The incidence reduction that would occur as a result of regulation is also evaluated for each cutoff level. These incidence and incidence reduction values are presented in the Supplement to the BID.

6.1.3 Secondary Impacts

Secondary air pollutants are those emissions that are not usually associated with an uncontrolled facility but result from the use of pollution control equipment (i.e., the control of one pollutant results in the production of another pollutant). No secondary air pollutants are expected to result from the use of acid-water scrubbers or condensation/reclamation systems and recirculating vacuum pumps. The only control device that might create secondary air pollutants is a flare burner. If a flare burner is used to control emissions of 12/88 (E0/CFC-12) gas rather than pure E0 (or an E0/CO₂ gas mixture), corrosive and toxic byproducts would result, and an acid mist scrubber would be required to control these secondary emissions. However, as stated in Chapter 3, flare manufacturers do not recommend that flares be used with 12/88, and the two facilities which reported using flares only used these flares to control pure E0 emissions. Therefore, secondary impacts from the use of flares are not expected.

6.2 WATER QUALITY AND SOLID WASTE IMPACTS

If an acid-water scrubber is used to control E0 emissions, there may be water quality or solid waste impacts, depending on how the spent

scrubber solution (predominately ethylene glycol) is disposed. Ethylene glycol is generated when the EO exhaust stream contacts and then reacts with the acid-water solution in the scrubber. When this solution is spent, the scrubber tank must be emptied and a fresh acid-water solution added. The Supplement to the BID presents the estimated amount of ethylene glycol solution that would be generated above baseline levels if all of the uncontrolled EO emissions from the chamber vents and drains were controlled by 99 percent efficient acid-water scrubbers. (A small number of existing facilities currently use acid-water scrubbers, but the baseline level of ethylene glycol generated is not known.) The amount of the ethylene glycol solution produced in the scrubber tank was calculated based on the assumption that the scrubber would be drained after 2,000 pounds of EO per tank were treated, resulting in a 64 percent (by weight) aqueous solution of ethylene glycol. Each tank initially holds about 220 gallons of a 10 percent (by volume) aqueous sulfuric acid (H_2SO_4) solution, which is neutralized with 50 percent (by weight) NaOH before the tank is drained.² (See Appendix F [example calculations for Baseline Category III, assumption 3] for a sample calculation of the amount of the ethylene glycol solution produced per pound of EO entering the scrubber.)

Several methods for final disposal of the ethylene glycol were examined. The ethylene glycol produced by the scrubber can be removed by a waste disposal company, sent to a municipal wastewater treatment plant, or shipped to a recovery plant. Removal of the ethylene glycol by a waste disposal company may not be economically practical for all of the facilities; this disposal method could be a high percentage of the annualized operating costs.² Sending the ethylene glycol solution to a municipal wastewater treatment plant also would not be feasible for all sterilization facilities. Some municipal treatment facilities restrict the concentration level and amount of ethylene glycol allowed in the discharge to the wastewater treatment plant.²

The final disposal method examined was shipping the ethylene glycol solution to a recovery company. At least three companies accept the ethylene glycol solutions for recovery.^{2,3} One of these companies will only accept the glycol in bulk quantities and, therefore, would not be an

appropriate disposal site for the users of small amounts of EO. The other two facilities will accept any quantity of the ethylene glycol solution at no cost to the producer except for freight.^{2,3} Therefore, shipment of the ethylene glycol solution to this company is a disposal method that would be applicable to all levels of EO users; this approach is the basis of cost estimates for disposal of spent scrubbing liquor.

6.3 ENERGY IMPACT

Contacts with industry have indicated that the EO emission control devices do not significantly increase the power or other energy requirements of the sterilization facilities. Therefore, no energy impacts are attributable to regulatory compliance.

6.4 OTHER ENVIRONMENTAL CONCERNS

6.4.1 Irreversible and Irretrievable Commitment of Resources

Regulatory compliance would not preclude the development of future control options nor would they curtail any beneficial use of the environment. No long-term environmental losses would result from regulatory compliance by commercial sterilization facilities.

6.4.2 Environmental Impact of Delayed Standards

No impacts on air pollution are associated with a delay in proposing and promulgating the standard because no growth is expected to occur in this industry over the next 5 years. Delaying the standard would result in possible solid waste impact reductions, but the reductions would be minimal compared with the air quality benefits attributable to promulgation of the standard.

6.5 REFERENCES FOR CHAPTER 6

1. Telecon. Soltis, V., MRI, with Jorkasky, J., HIMA. Discussion about predicted growth in the ethylene oxide sterilization industry. March 2, 1987.
2. Memorandum from Srebro, S., MRI, to Markwordt, D., EPA:CPB. Recommendation for costing the disposal of ethylene glycol produced by the Damas ethylene oxide scrubber. July 8, 1986. 2 p.
3. Memo from Srebro, S., MRI, to Markwordt, D., EPA:CPB. Capital cost, annualized cost, and cost effectiveness of reducing ethylene oxide emissions at commercial sterilization facilities. March 20, 1987.

7. COST ANALYSIS

7.1 INTRODUCTION

This section presents a summary of the cost analysis data. Emission reductions, total capital costs, and total annualized costs were estimated for each of the 82 cutoff levels (including baseline) described in Chapter 5. Cost impacts presented in this chapter are presented in December 1984 dollars.

The components that were costed for E0 emission control are discussed in Section 7.2.1. The assumptions used to calculate the control costs associated with regulatory compliance are discussed in Sections 7.2.2 through 7.2.5.

7.2 METHODOLOGY

Because baseline control technology is not the same at all plants, not all facilities were costed for all control technology components (see Chapter 5, Section 5.1.2). The baseline controls identified for the facilities can be categorized as: (1) existing oxidation units, (2) existing acid/water scrubbers, (3) existing low-efficiency control devices (e.g., condensers, caustic/water scrubbers), and (4) no control. For these cost analyses, facilities using neutral water scrubbers for control of E0 emissions were considered to be in the "no control" category, and, thus, these plants' baseline emissions are equal to their reported E0 use. One facility, however, reported 50 percent control of E0 emissions by using a neutral water bubbler combined with chemical treatment. This facility was considered to be in the "existing low-efficiency control" category. In the cost and regulatory analyses, baseline emissions for this facility reflect a 50 percent reduction of chamber vent emissions.

7.2.1 Description of Components Costed

The following components were costed to evaluate control of vent and drain EO emissions: (1) automated scrubber, (2) water-sealed vacuum pump(s) with closed-loop recirculation, (3) piping for manifolding the chambers to the control device, (4) operating materials (i.e., chemicals and chlorine filters), (5) scrubber waste disposal, and (6) labor.

Scrubber prices are listed in Table 7-1. The capital costs of the piping system for manifolding and the installed cost of the vacuum pump are presented in Tables 7-2 and 7-3. The costs of operating materials as well as the shipping charges used for computing disposal costs for the spent scrubber solution are presented in Table 7-4.¹

Costs reported in Tables 7-1 through 7-4 are in fourth quarter 1984 dollars. The prices for the scrubbers, vacuum pump, chlorine filters, and chemicals were obtained from the manufacturer and suppliers and were originally in 1986 dollars. These prices were converted to fourth quarter 1984 dollars using the CE Plant Cost Index (for the equipment) and the Current Business Indicators (for the chemicals) in Chemical Engineering.^{2,3} The labor costs were calculated from the GARD manual and from the CE Plant Cost Index.^{3,4} The indices used and the conversion factors obtained are reported in Appendix D.

7.2.1.1 General Assumptions. Chamber volume was used as the basis for scrubber sizing. A vacuum pump was then sized to provide evacuation of the chamber over a 15-minute period. (Upon completion of the EO exposure phase of sterilization, a vacuum pump is used to evacuate the chamber. The evacuation requires about 15 minutes and is repeated two to four times before products are removed from the chamber.) The relationship of chamber volume to scrubber size is presented in Table 7-1.¹

For these cost analyses, if a facility has three or more sterilization chambers, the scrubber costed was chosen based on the sum of the volumes of the two largest chambers at that facility. This methodology simulates the cost of controlling emissions from a facility if two chambers at that facility were to be evacuated simultaneously. If a facility has two chambers, the scrubber was selected based on the volume of the larger chamber. For facilities with two chambers, it was assumed that the sterilization cycles could be staggered so that the chambers would not be evacuated simultaneously.¹

The disposal cost for the aqueous ethylene glycol solution produced by the acid-water scrubbers was computed as the cost to ship the solution, either in 55-gallon drums or in a tank truck, depending on quantity, to a recovery facility. Two recovery facilities that will accept the ethylene glycol on a no cost/no payment agreement were identified; one facility was also identified that may, in the future, accept the ethylene glycol on a no cost/no payment agreement. Transportation costs were calculated by assuming that commercial sterilization facilities are within 1,000 miles of one of the three known recovery facilities.¹

7.2.1.2 Capital Costs. The fixed capital costs for a particular facility represent the initial investment and installation charges for control equipment necessary to achieve regulatory compliance. The cost data presented in Table 7-5 were used to calculate capital cost estimates for each of the facilities.¹

7.2.1.3 Annualized Costs. Annualized costs for a particular facility represent direct operating costs such as labor costs, cost of materials, and disposal costs, as well as indirect operating costs such as overhead charges, tax/insurance charges, and capital recovery costs. The cost data presented in Table 7-6 were used to estimate plant-specific annualized costs.¹

7.2.2 Baseline Category I--Facilities With Existing Oxidation Units

Two commercial sterilization facilities reported using flares to control EO emissions, and one facility uses a catalytic oxidizer. The reported efficiencies were 99.7 percent and 99.0 percent for the flares and 99.0 percent for the catalytic oxidizer. The facilities with the flares primarily use pure EO and flare pure EO only. No additional control devices were costed for the control of EO emissions from chamber vents at these facilities. However, the cost of a water-sealed vacuum pump with closed-loop recirculation to eliminate drain emissions was calculated for each chamber at these three facilities. Because all the chambers at each facility are manifolded to the existing control device, no additional piping was costed.¹

Sample calculations are presented in Appendix E.

7.2.3 Baseline Category II--Facilities With Existing Acid/Water Scrubbers

Fourteen commercial sterilization facilities have existing acid/water scrubbers with efficiencies reported to be equal to or greater than 99 percent. For these 14 facilities, no additional control devices were costed for the control of EO vent emissions. However, for each chamber at each facility, a water-sealed pump with a closed-loop recirculation system to eliminate EO drain emissions was costed. It was assumed that the existing control device could handle any additional emissions from the drain without modification. Thus, the only incremental costs of controlling the recovered drain emissions were assumed to be the cost of additional chemicals and the incremental cost of disposal of the aqueous ethylene glycol.¹

Two of these 14 facilities each have two chambers that are manifolded to an existing acid/water scrubber and two much smaller chambers that are uncontrolled. In addition, a third facility has two chambers, each with a dedicated acid/water scrubber, and one much smaller chamber that is uncontrolled. For these cost analyses, it was assumed that the existing scrubbers have sufficient capacity to handle the emissions from the smaller chambers and drains and that no scrubber modifications are needed. Thus, the incremental costs of controlling these emissions were assumed to be the following: (1) the cost of additional chemicals associated with control of the smaller chambers and drains, (2) the incremental scrubber waste disposal cost, and (3) the cost of the piping system for manifolding the smaller chamber(s) to the existing control device. All sterilization chambers at each of the other 11 facilities are manifolded to the facility's existing scrubber; therefore, no piping costs were calculated for these facilities.¹

Two facilities have existing acid/water scrubbers with reported efficiencies less than 99 percent (96 percent and 98 percent). However, both of these scrubbers are brand-name scrubbers which the manufacturers specify to be at least 99 percent efficient. Also, test data from a scrubber designed by one of these manufacturers indicated >99 percent control of EO emissions. Therefore, it was assumed that the efficiencies of these two scrubbers could be increased to 99 percent at minimal cost (e.g., by changes in the sterilizing cycle and/or in the operation of the

scrubber). Water-sealed vacuum pumps with closed-loop recirculation systems to recover drain emissions were costed for each chamber at the two facilities. The incremental costs of controlling the recovered E0 drain emissions were assumed to be the cost of additional chemicals and the incremental waste disposal cost. Because all the chambers at each facility are manifolded to the existing control device, no additional piping was costed.¹

Sample calculations are presented in Appendix E.

7.2.4 Baseline Category III--Facilities With Existing Low-Efficiency Control Devices

Nine facilities reported existing control devices other than acid/water scrubbers. The types of control devices and ranges of control efficiencies reported were as follows: (1) seven facilities use condensation/reclamation systems (50 to 88 percent), (2) one facility has two caustic/water scrubbers (30 and 95 percent), and (3) one facility uses a neutral water bubbler and a chemical treatment plant (50 percent).¹

For each of these facilities, the following components were costed: (1) an automated scrubber, (2) a water-sealed vacuum pump with closed-loop recirculation for each chamber, (3) piping for manifolding the chambers at a facility to a scrubber, (4) labor, (5) operating materials, and (6) scrubber waste disposal. Piping costs were calculated based on the assumption that all sterilization chambers at a facility would be manifolded to one scrubber. At eight of these nine facilities, some or all of the chambers are manifolded to the existing control device. For these facilities, piping costs were calculated for the chambers that are not already manifolded to the existing control device. For each of these nine facilities, it was assumed that all residual E0 emissions that are not controlled by the existing control device(s) would be controlled by a scrubber selected on the basis of chamber volume as described in Section 7.2.1.¹

Sample calculations are presented in Appendix F.

7.2.5 Baseline Category IV--No Control

The remaining 163 facilities reported no existing control of E0 emissions. For each of these facilities, the following components were costed: (1) a scrubber, (2) a water-sealed vacuum pump with closed-loop

recirculation for each chamber, (3) piping for manifolding all chambers at a facility to one scrubber, (4) labor, (5) operating materials, and (6) scrubber waste disposal.¹

Sample calculations are presented in Appendix F.

7.2.6 Results of Plant-Specific Cost Analyses

Table 7-7 presents a summary of the estimated total capital costs, total annualized costs, and emission reductions for each of the baseline categories.

7.3 COST IMPACTS

The cost impacts associated with each of the 82 cutoff levels are evaluated by estimating the cumulative emission reduction, capital cost, and annualized cost for all facilities that would have to comply with the regulation at a particular cutoff level. These cost impacts are presented in the "Supplement to the Commercial Sterilization BID--Environmental and Cost Impacts Associated with Regulatory Compliance."

TABLE 7-1. COST OF DAMAS SCRUBBER MODELS (F.O.B.)¹
(4th Quarter 1984 Dollars)

Model No.	Chamber size, m ³ (ft ³) ^a	Conversion capacity of scrubber, kg (lb) of EO	Automated scrubber cost, \$	Cost of explosion-proof valves for scrubber, \$ ^b
100	<11.3 (<400)	908 (2,000)	47,250	12,180
200	11.3 to 17.0 (400 to 600)	1,816 (4,000)	68,250	13,195
300	17.0 to 22.7 (600 to 800)	2,724 (6,000)	89,250	14,210
400	22.7 to 45.3 (800 to 1,600)	3,632 (8,000)	99,750	15,225
500	45.3 to 56.6 (1,600 to 2,000)	4,540 (10,000)	141,750	17,255
600	>56.6 (>2,000)	5,448 (12,000)	157,500	18,270

^aThe size of sterilization chamber that can be served by the model number, assuming the smallest appropriate vacuum pump is used.

^bExplosion-proof valves are necessary if the sterilization chamber that is vented to the scrubber uses a gas mixture greater than 20 percent by weight (w/w) EO.

TABLE 7-2. INCREMENTAL CAPITAL COSTS OF MANIFOLDING
STERILIZATION CHAMBERS¹

Item	Cost, 1984 \$
<u>Opening in explosion-proof wall^a</u>	
Adjustable sheetmetal sleeve ^b	2
Labor costs at \$18.05/hour	93
Overhead costs at \$8.35/hour	43
<u>Drill holes for pipe hangers^c</u>	
Labor costs at \$19.40/hour	146
Overhead costs at \$15.06/hour	113
<u>Piping^d</u>	
100 ft, 2 in. diameter, 40 standard carbon steel pipe	240 ^b
90° elbows, 3 at \$4.19	13 ^b
Tee with full-size outlet	14 ^b
Swing check valve	350 ^b
Bolts and gaskets, two sets at \$6.76	14 ^b
Pipe hangers, 1 carton of 50 hangers	140 ^b
Labor costs at \$20.50/hour	576
Overhead costs at \$12.71/hour	357
<u>Total installed cost for piping system</u>	
Total direct costs ^e	1,588
Total indirect costs:	
Overhead costs ^f	513
Administration ^g	159
Taxes ^h	39
Total installed cost ⁱ	2,299
<u>Total installed cost for recirculating vacuum pump</u>	4,935
<u>TOTAL CAPITAL COST</u>	7,234

^aRequires 5.15 labor-hours.

^bEquipment cost.

^cRequires 7.5 labor-hours.

^dRequires 28 labor-hours.

^eSum of all labor and equipment costs.

^fSum of all overhead costs.

^gTen percent of total direct costs.

^hFive percent of total equipment costs.

ⁱ(Total direct costs)+(total indirect costs).

TABLE 7-3. CAPITAL COST OF CHECK VALVE FOR CHAMBER¹

Cost item	Cost, 1984 \$
Swing check valve	350 ^a
Installation costs ^b	
Labor costs at \$20.50/hour	23
Overhead costs at \$12.71/hour	14
Total direct costs ^c	373
Administration: 10 percent of total direct costs	37
Taxes: 5 percent of equipment cost	18
Total indirect costs ^d	69
Total installed cost ^e	442
Annualized capital recovery cost ^f	74

^aEquipment cost.

^bRequires 1.1 labor hours to install.

^cSum of all labor and equipment costs.

^dSum of overhead costs, taxes, and administration.

^e(Total direct costs)+(total indirect costs).

^fCalculated as $0.16275 \times (\text{total installed cost})$, for an interest rate of 10 percent and a 10-year recovery period.

TABLE 7-4. MISCELLANEOUS OPERATING COSTS¹

Item description	Cost, 1984 \$
<u>Operating materials</u>	
1. 50 percent H ₂ SO ₄ , electrolyte-grade	0.069/lb
2. 50 percent NaOH, industrial grade:	
<2 drums	0.108/lb
3-9 drums	0.0787/lb
>9 drums	0.0738/lb
3. Chlorine filters:	
Filter housing	41.50 each
Filter	15.00 each
Installation	20.00 each
<u>Shipping charges for waste disposal</u>	
Weight of solution for disposal:	
<42,000 lb (drums)	0.096/lb
≥42,000 lb (bulk)	0.059/lb

TABLE 7-5. DATA USED TO CALCULATE CONTROL EQUIPMENT CAPITAL COSTS¹
(4th Quarter 1984 Dollars)

Item	Cost factor
Automated scrubber	-- ^a
Explosion-proof valves for scrubber	-- ^{b c}
Chlorine filter house	(\$41.50 each)x(No. of tanks) ^d
Scrubber installation	50 percent of scrubber cost
Chlorine filter installation	(\$20.00)x(No. of tanks) ^d
Taxes	5 percent of total equipment cost
Freight	5 percent of total equipment cost
Vacuum pump(s)	\$4,935 per pump
Manifolding of chambers (includes check valve)	-- ^e

^aFunction of chamber size (see Table 7-1).

^bFunction of chamber size (see Table 7-1).

^cExplosion-proof valves are necessary if the chamber that is vented to the scrubber uses a gas mixture greater than 20 percent (w/w) E0.

^dNumber of scrubber tanks required = scrubber conversion capacity divided by the conversion capacity of one tank (2,000 pounds of E0).

^eSee Tables 7-2 and 7-3.

TABLE 7-6. DATA USED TO CALCULATE CONTROL DEVICE ANNUALIZED COSTS¹
(4th Quarter 1984 Dollars)

Item	Cost factor
<u>Direct operating costs</u>	
Labor	$\$3,177 + (\$11.60) \times (16 \text{ person-hours}) \times (\text{No. of scrubber regenerations})^a b$
Materials:	
50 percent H ₂ SO ₄	$(\$0.069/\text{lb}) \times (594 \text{ lb/drum}) \times (\text{No. of drums required})^c d$
50 percent NaOH	$(\text{Cost}/\text{lb}) \times (700 \text{ lb/drum}) \times (\text{No. of drums required})^c, e, f$
Chlorine filters	$(\$15/\text{filter}) \times (\text{No. of tank regenerations})^c g$
Taxes	5 percent of materials cost
Freight	5 percent of materials cost
Compressed air	0^h
Disposal of ethylene glycol	$_{-}^i$
<u>Indirect operating costs</u>	
Overhead	$(0.8) \times (\text{labor costs})$
Property tax, insurance, and administration	4 percent of total capital costs
Capital recovery costs	$(0.16275) \times (\text{total capital costs})^j$

(continued)

TABLE 7-6. (continued)

a	Number of scrubber regenerations = amount of E0 to be treated divided by the conversion capacity of the scrubber (See Table 7-1).
b	The \$3,177 is for visual inspection of the system 15 minutes per shift, 3 shifts per day, 365 days per year at \$11.60/person-hour. It was assumed that each regeneration of the scrubber solution would require two people at 8 person-hours each, independent of scrubber size.
c	Number of scrubber tanks required = scrubber conversion capacity divided by the conversion capacity of one tank (2,000 pounds of E0). Number of tank regenerations = amount of E0 to be treated divided by the conversion capacity of one tank.
d	Each tank regeneration requires one 55-gallon drum of 50 percent H_2SO_4 .
e	Each tank regeneration requires 250 pounds of NaOH for neutralization.
f	Cost basis for 50 percent NaOH (350 pounds NaOH per drum):
	If No. of drums > 9, cost/lb = \$0.0738
	If No. of drums = 3 to 9, cost/lb = \$0.0787
	If No. of drums < 2, cost/lb = \$0.108
g	Each chlorine filter can dechlorinate approximately 200 gallons (one tank) of H_2O ; replace filter at each tank regeneration.
h	The cost of 10 seconds of in-house compressed air per cycle is considered negligible.
i	Unit cost of disposal was calculated by multiplying the total number of tank regenerations by the weight of a tank at regeneration, approximately 4,845 lb (see Example Calculation No. 3 for Baseline Category III in Appendix E [page E-2]).
	If the total weight < 42,000 lb, disposal cost = (weight) x (\$0.096/lb).
	If the total weight > 42,000 lb, disposal cost = (weight) x (\$0.059/lb).
j	Assumes an interest rate of 10 percent and a 10-year recovery period.

TABLE 7-7. SUMMARY OF CONTROL DEVICE COST ANALYSES¹
(4th Quarter 1984 Dollars)

Individual facilities, range ^{a b}	Total capital costs, \$	Total annualized costs, \$	Incremental emission reduction, Mg EO
Baseline Category I	4,940 to 19,700	1,000 to 4,000	0.212 to 43.6
Baseline Category II	4,940 to 39,500	1,300 to 16,600	0.410 to 26.5
Baseline Category III	94,100 to 296,000	24,900 to 105,000	0.123 to 82.9
Baseline Category IV	75,700 to 318,000	21,100 to 117,000	0.001 to 102
TOTAL FOR INDUSTRY	23,100,000	6,620,000	1,750

^aThe results reported for Baseline Categories I through IV are the range of values obtained for individual facilities in each of these categories. (See Sections 7.2.2 through 7.2.5 for descriptions of the baseline categories.)

^bBaseline Category I: Facilities with existing oxidation control devices.

Baseline Category II: Facilities with existing acid/water scrubbers.

Baseline Category III: Facilities with existing low-efficiency control devices.

Baseline Category IV: Facilities with no existing control device.

7.4 REFERENCES FOR CHAPTER 7

1. Memorandum from Srebro, S., MRI, to Markwordt, D., EPA/CPB. Capital cost, annualized cost, and cost effectiveness of reducing ethylene oxide emissions at commercial sterilization facilities. March 20, 1987.
2. Chemical Engineering. Economic Indicators. February 18, 1985. p. 7.
3. Chemical Engineering. Economic Indicators. June 23, 1986. p. 7.
4. Neveril, R., Capital and Operating Costs of Selected Air Pollution Control Systems. GARD, Inc. Niles, Illinois. Publication No. EPA-450/5-80-002. December 1978. p. 3-11, 12, 16.

CHAPTER 8

ECONOMIC IMPACT ANALYSIS FOR THE COMMERCIAL STERILIZATION NESHAP

8.1 PROFILE OF THE COMMERCIAL STERILIZATION PROCESS

This economic profile focuses on the commercial process of ethylene oxide (EO) sterilization/fumigation of medical equipment and other miscellaneous products, excluding sterilization activities in hospitals. For simplicity, we hereafter refer to this process simply as sterilization. For a variety of reasons discussed later in this section, sterilization does not form a cohesive industry, but is instead a part of the production process in several industries. Therefore, this profile will be limited in the scope of its analysis. The most important limiting factor is the lack of data on sterilization as a separate step in the production process. Consequently, we use an approach in which commercial sterilizers are grouped by industry; sterilization is then analyzed within the context of that industry. In addition, an industry profile would ideally follow a model of industrial organization that analyzes an industry in the context of its basic conditions, market structure, market conduct, and market performance.¹ However, isolation of the necessary economic factors for this kind of analysis is not possible since sterilization is just one step in production processes.

The profile is divided into three major sections. Section 8.1.1 provides a general background on sterilization. Section 8.1.2 briefly describes the actual sterilization process. These sections, which are not meant to repeat information stated in previous chapters, provide an economic perspective on various aspects of the sterilization process. Finally, Section 8.1.3 presents relevant data on the industries that use this process.

8.1.1 Background on Sterilization

Ethylene oxide was developed as a sterilizer during World War II when the U.S. Army investigated ways to sterilize germ-warfare materials.

Widespread acceptance of EO as a sterilizer began in 1949 when the Army released the results of its study. Since that time, EO has had a profound impact on health care because of its ability to sterilize plastics. This has allowed the health care industry to use plastic products that are versatile, convenient, and economical.² However, the use of EO as a sterilizer is not limited to the health care industry. Ethylene oxide is used as a sterilant/fumigant by pharmaceutical manufacturers, spice manufacturers, and museums, as well as medical equipment suppliers.

Products may be sterilized for several reasons. The main reason concerns the ultimate safety and effectiveness of the object that is sterilized. Specifically, many products cannot be marketed unless they meet U.S. Food and Drug Administration sterilization standards. For example, inadequate sterilization, especially by medical equipment suppliers, can lead to harmful health effects for users of the supplies. Sterilization is, therefore, a necessary process for these products. Other miscellaneous sterilization and fumigation procedures, such as those used by museums, greatly enhance an object's value or useful life.

There are several ways that products can be sterilized or fumigated. The most popular methods use either a sterilant gas, gamma radiation, heat, or steam. Sterilization facilities use EO as a sterilant gas either alone or mixed with an inert gas. The most widely used sterilant gas is referred to as 12/88, which is 12 percent EO and 88 percent dichlorodifluoromethane (CFC-12) by weight.³ Another common sterilant gas is a mixture of carbon dioxide (CO₂) and EO. The percentage of EO in the EO/CO₂ mixture can range from less than 10 percent by weight up to 80 percent (or more) by weight.

The economic analysis presented in this chapter covers 191 sterilization facilities for which data are available from two recent surveys. About half of the 191 facilities are suppliers of medical equipment or other health-related items; the other facilities engage in several miscellaneous sterilization and fumigation operations (discussed later). As shown in Figure 8-1, the facilities are located throughout the United States and Puerto Rico, but are concentrated in the East and upper Midwest.

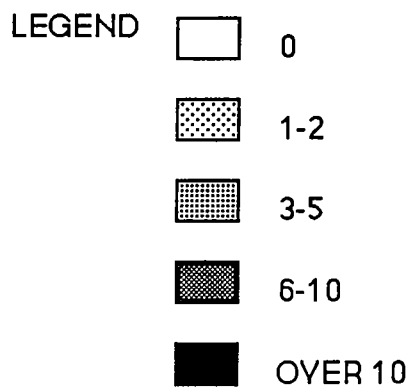
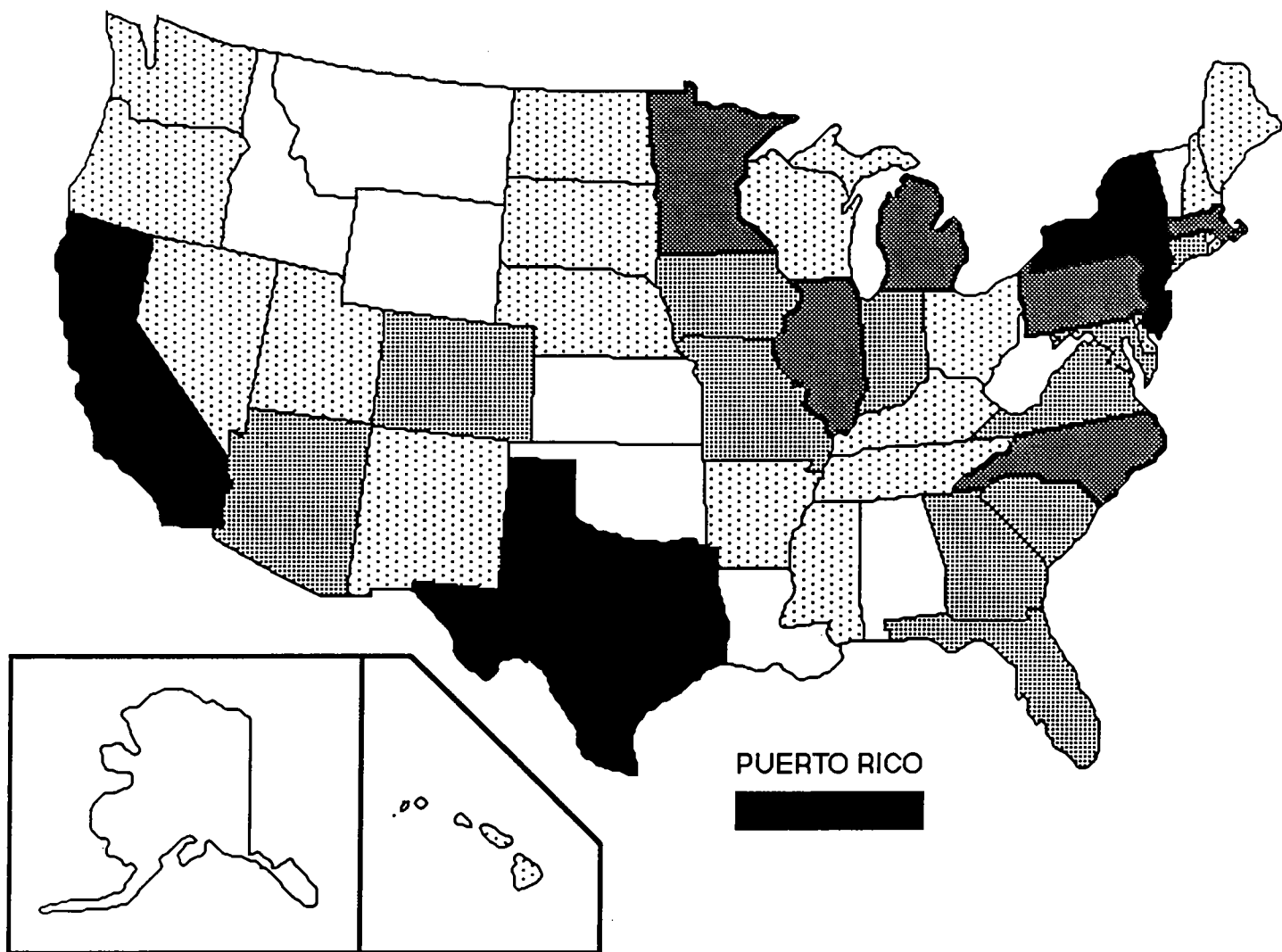


Figure 8-1. Distribution of 191 commercial sterilization facilities by state, 1986.⁵

As discussed above, several characteristics of the sterilization process make it difficult to profile the process as a distinct industry. The most important characteristic stems from the role of sterilization in the overall production process. Except for contract sterilizers, the sterilization process is an intermediate step in the production process. Therefore, it is difficult to separate sterilization from the production of the sterilized products. Another difficulty is the absence of a SIC code listing for sterilization either separately or within the classifications for the industries that employ this process. Furthermore, EO sterilization accounts for only 50 to 60 percent of all sterilization activities.⁶ Finally, the diversity and specialization of the industries that sterilize products limit the amount of data available for this profile.

In 1986, approximately 2,250 megagrams (2,490 tons) of EO were used for sterilization purposes by the 191 facilities covered in this analysis.*⁷ Table 8-1 presents some summary statistics on the use of the sterilant gases at the 191 facilities, separated into two categories--EO use and total gas use. The tremendously wide range in the use of sterilant gas per facility is noteworthy.

8.1.2 Sterilization Process

This section describes the sterilization process, inputs into the sterilization process, and substitution possibilities among types of sterilization.

8.1.2.1 Description of Process Technology. The sterilization process involves four main phases: presterilization conditioning, sterilization phase, evacuation phase, and aeration. The different types of sterilant gases have similar sterilization cycles; the main differences between the processes are the operating pressures of the sterilization chamber.

After the products have been loaded into the sterilization chamber, the chamber pressure is lowered with a vacuum pump in what is called the initial drawdown. The temperature and relative humidity in the chamber are then adjusted. Next, the sterilant gas is pumped into the chamber to

*Approximately half of the data in the EPA commercial sterilization database are 1985 values; the remainder are 1986 values.

TABLE 8-1. SUMMARY STATISTICS ON THE USE OF STERILANT GAS AT 191
COMMERCIAL STERILIZATION FACILITIES, 1986⁸

		Ethylene oxide	Total gas ^a
Total use	(Mg/yr)	2,250	7,890
Use per facility			
Average	(kg/yr)	11,800	41,500
Range	(kg/yr)	1 - 109,000	6 - 443,000
Use per chamber			
Average	(kg/yr)	5,380	18,600
Range	(kg/yr)	<0.5 - 79,800	2.3 - 199,000
Use per chamber volume ^b			
Average	(kg/m ³ /yr)	253	1,300
Range	(kg/m ³ /yr)	1 - 1,620	8 - 7,970

^aOne facility did not report its total gas use and has been omitted.

^bThe sum over all facilities of the gas used at each facility divided by each facility's chamber volume, divided by the number of facilities.

achieve the desired concentration of EO. Many facilities sterilize with a concentration of approximately 600 milligrams of EO per liter (8.49 grains per quart) inside the chamber; however, some facilities use concentrations as high as 1,000 milligrams per liter (14.5 grains per quart).

During the sterilization phase, the chamber pressure is set according to the requirements of the sterilant gas and is maintained at that level for 2 to 16 hours. At the conclusion of the sterilization phase, the chamber is evacuated, and the pressure is returned to the level achieved during the initial drawdown. Following evacuation, filtered air is introduced into the chamber. The evacuation/air wash is then repeated two to four times. Finally, the products are aerated either in the sterilization chamber or in a separate aeration room. The aeration phase can last from 12 hours to several days, depending on the aeration procedure and the type of product sterilized.

8.1.2.2 Process Inputs. The gases used for sterilization are a primary input into the sterilization process. As noted earlier, several different sterilant gases fall under the broad category of ethylene oxide sterilization--pure EO, 12/88, and EO/CO₂ mixtures.

The importance of EO to the sterilization process lies mainly with the chemical's ability to sterilize a wide variety of products. Ethylene oxide can sterilize almost any product that is contained in a permeable package and can withstand temperatures up to 57 °C (135 °F) and pressures of between -15 psig and +15 psig. However, liquids and products in vapor-tight packages cannot be sterilized effectively with EO.⁹

The major capital equipment requirement for sterilization is the sterilization chamber. The 191 facilities covered in this profile operate 422 chambers, an average of 2.2 chambers per facility. The number of chambers per facility ranges from one to nine. Chamber sizes range from 0.01 m³ (.35 ft³) to 177 m³ (6250 ft³) and average about 16 m³ (565 ft³).¹⁰ A typical chamber has a useful life of approximately 10 years; at the end of that time, the salvage value of the chamber is less than 1 percent of the initial capital investment.¹¹

Certain design characteristics of the sterilization chamber are determined by the gas to be used for sterilization. These design charac-

teristics limit the possibility of switching gases in the short run. When pure EO is used, the chamber instrumentation and room must be explosion-proof.¹² Pure EO chambers must also operate with a deep vacuum to rid the chamber of oxygen.¹³ Chambers that use an EO/CO₂ mixture, which requires a substantially higher operating pressure than other gases, have to meet higher standards of construction in order to withstand the pressure.¹⁴

The various chamber specifications are not mutually exclusive. For example, a chamber designed to withstand the high operating pressure associated with the EO/CO₂ mixture can also accommodate the lower pressures required by other sterilant gases. Therefore, some facilities have chambers with the characteristics necessary for use with more than one type of sterilant gas. Consequently, these facilities have the ability to alternate between gases to achieve optimal combinations of product and sterilant gas for each sterilization cycle. Facilities involved in testing and research and those that sterilize a wide variety of products are more likely to operate chambers in this manner.

Other equipment required for the sterilization process includes:

- A pump to create a vacuum in the chamber
- A pump to force sterilant gas or air into the chamber
- Chamber vents and pump drains for use in the evacuation and aeration process.

Some facilities also have a separate room for the aeration step of the process, although aeration can be accomplished in the sterilization chamber so that products do not have to be moved.

Labor requirements for EO sterilization are usually higher than for other types of sterilization (e.g., thermal or radiation). Each sterilization cycle must be closely monitored because there are several critical process variables that require careful attention.¹⁵ In addition, sterilization with pure EO requires strict safety precautions and extensive monitoring by facility personnel, since that gas is flammable.

8.1.2.3 Substitution Possibilities. The extent of substitution between the EO-based gases is limited by the characteristics of the sterilization chamber and the compatibility of the sterilizing medium with the products

being sterilized. As noted earlier, both pure EO and the EO/CO₂ mixtures may require specially designed sterilization chambers. Chambers may be modified to use pure EO, but industry standards prohibit modification of chambers for use with the EO/CO₂ mixture. However, the different pressures under which sterilization is performed for each sterilant gas can damage some products or packaging. Consequently, substitution to sterilant gases that require extremely high or low operating pressures is limited by the characteristics of the products being sterilized.

Gamma radiation sterilization can substitute for EO sterilization for many products. Unlike EO, radiation can sterilize liquids and products in vapor-tight packages; however, it discolors plastics and damages Teflon and acetyl delrin.^{16,17} Gamma radiation is expected to make inroads into the EO market for sterilization, perhaps gaining an additional 10 percent of the sterilization market.¹⁸ While gamma radiation is a likely substitute for EO sterilization, safety concerns regarding transportation and disposal of the radiation source will probably limit any increase in the percentage of the products sterilized by radiation.*¹⁹

The importance of the sterilization procedure in the overall production process of many products presumably has a profound effect on its demand elasticity, i.e., the responsiveness of quantity demanded to a change in the price of sterilization services. There are four main influences on the elasticity of demand for a factor within an industry.²⁰ Specifically, the elasticity of demand should vary directly with the elasticity of demand for the final product, the factor's share of the costs of production, the elasticity of supply of other factors, and the elasticity of substitution between the factors.

These influences suggest that the demand for sterilization within the relevant industries is relatively inelastic. This conclusion is based in part on the low ratio between the cost of sterilization and the total cost

*Several other chemical substitutes for EO exist, but their use is more limited than gamma radiation. The substitution possibilities for these chemicals are discussed in later sections in conjunction with the appropriate end products.

of production.²¹ Additionally, the elasticity of substitution between factors of production within the industries is relatively low; precautions taken to minimize contamination during production do not necessarily lessen the need for sterilization, but enhance the effectiveness of the process. Generalizations regarding the elasticity of demand for the final product and the elasticity of supply of other factors are not possible due to variations from industry to industry.

8.1.3 Profile of Industries Using Sterilization

There are several main categories of facilities that sterilize some portion of their output: medical equipment suppliers; other health-related suppliers; pharmaceutical manufacturers (and other drug-related manufacturers); spice manufacturers (and other food-related manufacturers); museums and libraries; laboratories (research, testing, and animal breeding); and contract sterilizers. Table 8-2 summarizes the specific Standard Industrial Classification (SIC) codes associated with these industry categories, and the number of facilities in each. As might be expected from the large number of SIC codes, the 191 sterilization facilities sterilize a wide variety of products. These products range from surgical gloves and hypodermic needles sterilized by medical equipment suppliers to books fumigated by libraries and museums to the spices fumigated by spice manufacturers.

As discussed earlier, the sterilization processes used by the above industries have several similarities. However, a distinction can be made between in-house sterilization and contract sterilization. A majority of the facilities covered in this profile operate a sterilization chamber at the same location as the remainder of the production process. The exception to this rule is the subset of commercial sterilizers that sterilize products for other companies on a contract basis. Not only do contract sterilizers accept a variety of products for sterilization, but they may also supervise the final distribution of the products. It should be noted that the distinction between these two types of sterilization is not always well-defined. There are facilities, especially within the medical equipment supplies and pharmaceutical industries, that sterilize their own products in-house and also accept products on a contract basis from other firms.

TABLE 8-2. STANDARD INDUSTRIAL CLASSIFICATION CODES FOR 191
COMMERCIAL STERILIZATION FACILITIES, 1986²²

SIC Code	No. of facilities	Description of category
Medical equipment suppliers = 62		
3841	44	Surgical and medical instruments and apparatus
3842	18	Orthopedic, prosthetic, and surgical appliances and supplies
Other health-related suppliers = 25		
3079	7	Miscellaneous plastic products
3693	5	Radiographic x-ray, fluoroscopic x-ray, therapeutic x-ray, and other x-ray apparatus and tubes; electrochemical and electrotherapeutic apparatus
5086	4	Professional equipment and supplies
2211	2	Broad woven fabric mills, cotton
2821	2	Plastics materials, synthetic resins, and nonvulcanizable elastomers
2879	1	Pesticides and agricultural chemicals, NEC
3069	1	Fabricated rubber products, NEC
3569	1	General industrial machinery and equipment, NEC
3677	1	Electronic coils, transformers, and other inductors
3999	1	Manufacturing industries, NEC
Pharmaceutical manufacturers = 40		
2834	34	Pharmaceutical preparations
5122	3	Drugs, drug proprietaries, and druggist's sundries
2831	2	Biological products
2833	1	Medicinal chemicals and botanical products

(continued)

TABLE 8-2 (continued)

SIC Code	No. of facilities	Description of category
Spice manufacturers = 24		
2099	17	Food preparations, NEC
5149	3	Groceries and related products, NEC
2034	2	Dried and dehydrated fruits, vegetables, and soup mixes
2035	1	Pickled fruits and vegetables, vegetable sauces and seasonings, and salad dressings
2046	1	Wet corn milling
Museums and libraries = 13		
8411	11	Museums & art galleries
8231	2	Libraries & information centers
Laboratories = 11		
0279	4	Animal specialties, NEC
7391	2	Research and development labs
8071	2	Medical labs
8922	2	Noncommercial educational, scientific, and research organizations
7397	1	Commercial testing labs
Contract sterilizers = 16		
7399	14	Business services, NEC
7218	1	Industrial launderers
8091	1	Health and allied services, NEC

NEC = Not elsewhere classified.

8.1.3.1 Medical Equipment Suppliers. Sterilizers of medical equipment (SIC 3841 and 3842) represent the largest single segment of commercial sterilizers covered in this analysis, having 62 of the 191 facilities. The total annual output of medical equipment sterilized in the United States is estimated as 15 to 20 billion products, with at least 50 percent of these products sterilized with EO.²³

As indicated earlier, some medical equipment must be sterilized in order to be marketed. Ethylene oxide, especially the 12/88 mixture, is used for medical equipment sterilization because of its wide range of effectiveness. The U.S. Food and Drug Administration (FDA) has set strict guidelines for medical equipment sterilizers to ensure achievement of necessary levels of sterility. These guidelines, called Good Manufacturing Practices (GMP), include requirements for such things as preliminary testing, procedural supervision, quality assurance, and final labeling.²⁴

In the last few years, the medical equipment industry has been under pressure to reduce health-care costs. The cost containment measures have resulted in decreased hospitalization time and fewer surgical procedures. Consequently, medical equipment suppliers face declining demand from traditional health-care providers, which has heightened price competition among the suppliers. Emerging alternatives to hospitals, such as health maintenance organizations, have countered this trend somewhat by opening new markets for medical equipment suppliers. However, the medical equipment industry must continue to adjust to the increasingly cost-conscious environment of health care. The medical equipment industry is expected to grow at a rate of 6 to 7 percent through the year 1991.²⁵

Although a wide range of products are included under the broad category of medical equipment, it is still possible to generalize about the importance of the products. Medical equipment is a basic part of the health-care service, which is a necessary service. Therefore, the elasticity of demand for medical equipment should be highly inelastic. However, the trends mentioned above, i.e., increased price competition among health care facilities and increased use of alternatives to hospitals, may be indications that the demand for medical equipment is becoming more elastic.

According to the Census of Manufactures, there were over 2,200 medical equipment suppliers in 1982.²⁶ Table 8-3 summarizes various statistics for this industry. Product data were collected for all products classified in either SIC 3481 or 3842 that are produced by all industries; industry data represent all facilities classified in either SIC 3841 or 3842, including their output of non-medical products.

The data presented in Table 8-3 reveal several trends within the industry. The total value of shipments for medical equipment suppliers is given in current dollars and in 1982 dollars. In both instances, the value of shipments has continually increased, although the rate of increase has diminished in recent years. Additionally, total employment has increased steadily from 1972, while production workers have consistently represented 65 to 70 percent of the total workforce. Another interesting trend is the dramatic increase in foreign trade within the medical equipment industry. Not only have imports and exports risen in absolute terms, but imports have increased as a percentage of value of shipments. Shipments between the United States and the European Economic Community account for 37 percent of exports and 50 percent of imports. The United States maintains a trade surplus in medical equipment with all its major trading partners except West Germany and Japan. This trade surplus, which decreased every year from 1981 to 1986, is expected to rise in 1987.²⁹

Table 8-4 shows some summary statistics on the sterilization chambers and sterilant gases used by the 62 medical equipment suppliers included in this study. These 62 facilities operated a total of 158 E0 sterilization chambers in 1986, an average of 2.5 per facility. The number of chambers per facility varied from one to eight. Average chamber volume per facility was 41.8 m³ (1,476 ft³); but covered a wide range from 0.2 m³ (8 ft³) to 272 m³ (9,590 ft³). In 1986, these 62 facilities used 877 Mg (969 tons) of E0, slightly over 14 Mg (15 tons) per facility. Like chamber volume per facility, E0 use varied widely from 0.01 Mg (.01 tons) to 109 Mg (120 tons). Total gas use, which averaged 49.9 Mg (55 tons) per facility, also covered a wide range--the smallest user reporting 0.05 Mg (.06 tons) and the largest reporting 418 Mg (462 tons).

TABLE 8-3. RECENT PERFORMANCE AND FORECAST DATA FOR MEDICAL EQUIPMENT SUPPLIERS (SIC 3841 AND 3842) a, 27

	1972	1975	1980	1981	1982	1983	1984	1987b
<u>Product data</u> ^c								
Value of shipments (10 ⁶ \$)	2,126	3,302	6,185	7,483	9,291	9,994	10,615	13,580
Value of shipments (10 ⁶ 1982\$)	4,435	5,243	6,892	7,744	9,291	9,696	9,819	11,900
<u>Industry data</u> ^d								
Total employment (10 ³ people)	78.4	94.4	113.1	119.5	125.7	129.5	135.1	151.5
Production workers (10 ³ people)	54.1	64.1	75.8	79.4	84.6	85.7	89.2	100.5
Capital expenditures (10 ⁶ \$)	89.5	157.6	281.0	374.0	418.0	371.0	480.0	NA
Value added ^e (10 ⁶ \$)	1,559.0	2,240.9	4,077.3	5,013.0	6,335.6	NA	NA	NA
<u>Trade Data</u>								
Value of imports ^f (10 ⁶ \$)	44.2	106.4	268.4	289.6	330.0	367.0	478.0	799.0
Value of exports ^f (10 ⁶ \$)	217.6	432.0	698.0	922.0	980.0	981.0	1,060.0	1,314.0

NA = not available.

aNumbers represent the sum of the values of the two industry groups.

bForecast.

cRepresents products classified in SIC codes 3841 and 3842 produced by all industries.

dRepresents all facilities classified as SIC 3841 and 3842.

eSource: Reference 28.

fDeveloped by International Trade Administration

TABLE 8-4. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 62 MEDICAL EQUIPMENT SUPPLIERS, 1986³⁰

	Average	Standard deviation	Range
Sterilization chambers = 158			
Number per facility	2.5	1.8	1 - 8
Chamber volume per facility (m ³)	41.8	58.0	0.2 - 272
Ethylene oxide use = 876.5 Mg/yr			
Use per facility (Mg/yr)	14.1	23.6	<0.05 - 109
Use per chamber volume (kg/m ³ /yr)	287	256	10.3 - 1,260
Total gas use = 3,096.0 Mg/yr			
Use per facility (Mg/yr)	49.9	77.2	<0.05 - 418
Use per chamber volume (kg/m ³ /yr)	1,468	1,351	45.8 - 6,927

By subtracting EO use from the total gas use, and then dividing by EO use, an inert-gas ratio is obtained. This ratio indicates the extent of reliance on pure EO versus mixed sterilant gases. In particular, a ratio near zero would suggest extensive reliance on pure EO (because EO use and total gas use would be almost identical), while a much higher ratio would indicate greater use of sterilant mixtures, such as 12/88. During 1986, the inert-gas ratio for the 62 medical equipment suppliers was 2.5.

8.1.3.2 Other Health-Related Suppliers. There are 25 facilities included in this study that produce some type of health-related supplies but are classified under a more general SIC code (see Table 8-2). For example, there are five facilities whose primary SIC code involves the manufacturing of x-ray equipment and nine facilities who manufacture various plastic products. The large number of SIC codes illustrates the diversity of industries that sterilize health-related equipment with EO. For this reason the value of shipments in Table 8-3 was presented on a product basis rather than on an industry basis. No other data specific to the relevant SIC codes will be presented.

Table 8-5 provides some summary statistics on the sterilization chambers and sterilant gas used by the 25 other health-related suppliers included in this study. These 25 facilities operated a total of 57 sterilization chambers in 1986, an average of 2.3 per facility. This is slightly lower than the medical equipment suppliers group, which averaged 2.5 chambers per facility.

The other health-related suppliers used 233.2 Mg (258 tons) of EO in 1986. They averaged 9.3 Mg (10 tons) per facility covering a range of 0.002 Mg (.0022 tons) to 42.0 Mg (46 tons). These facilities used less EO than the medical equipment suppliers, both in total and per facility. However, their total gas use per facility was higher than the medical equipment suppliers. This suggests that the other health-related suppliers rely less on pure EO and more on mixed sterilant gas than the medical equipment suppliers. Comparing the inert-gas ratios confirms this conclusion. Medical equipment suppliers have an inert-gas ratio of 2.5, while the other health-related suppliers have an inert-gas ratio of 5.3.

TABLE 8-5. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 25 OTHER HEALTH-RELATED SUPPLIERS, 1986³¹

	Average	Standard deviation	Range
Sterilization chambers = 57			
Number per facility	2.3	1.5	1 - 6
Chamber volume per facility (m ³)	43.7	49.0	0.4 - 207
Ethylene oxide use = 233.2 Mg/yr			
Use per facility (Mg/yr)	9.3	11.7	<0.05 - 42.0
Use per chamber volume (kg/m ³ /yr)	212	123	5.5 - 467
Total gas use ^a = 1,461.2 Mg/yr			
Use per facility (Mg/yr)	60.9	75.8	<0.05 - 342
Use per chamber volume (kg/m ³ /yr)	1,660	1,020	45.8 - 3,890

^aOne facility did not report its total gas use and has been omitted.

8.1.3.3 Pharmaceutical Manufacturers. The broad category of pharmaceutical manufacturers includes those facilities whose SIC code was either 2834, 5122, 2831, or 2832. These facilities are all connected with pharmaceutical preparations or other medicinal or biological products as a manufacturer or, in some cases, as a wholesaler. However, a vast majority of the facilities operate in SIC 2834. Therefore, the profile of pharmaceutical manufacturers is focused on that industry group. Sterilization has a variety of uses in this industry, but it is as closely tied to the ultimate safety and effectiveness of the products as in the medical equipment industry.

The pharmaceuticals industry has been facing eroding profit margins as a result of two trends. One is the dramatic increase in generic drugs in all sectors of the industry; the other is the increasing cost of research and development for new pharmaceuticals.³² Another factor in the economic status of the pharmaceuticals industry is the proliferation of patent piracy. The industry classified under SIC 2834 is especially susceptible to this problem because of its reliance on new products and heavy expenditures on research and development.³³

The U.S. Department of Commerce projects moderate long-term growth for pharmaceutical manufacturers. Industry and product shipments are expected to increase at an annual rate of 3 percent through 1991.³⁴ The costs of research and development will continue to increase, but at a lower rate than in recent years. The market for over-the-counter drugs has been expanding at a rate of 4 percent per year and this growth is expected to continue, mainly due to the change in status of drugs from prescription to over-the-counter.³⁵ Generic drugs, which currently represent one-third of the adult market, are predicted to show dramatic growth. The most significant increases will occur from 1987 to 1989, as a large number of patents expire.³⁶

According to the Census Bureau, there were a total of 683 facilities classified under SIC code 2834 in 1982. Of these 683 facilities, only 34 have been identified as commercial sterilizers. The pharmaceuticals group, as defined in this chapter, includes six additional facilities from SIC codes 5122, 2831, and 2833. Table 8-6 reports recent performance and

TABLE 8-6. RECENT PERFORMANCE AND FORECAST DATA FOR PHARMACEUTICAL MANUFACTURERS (SIC 2834)³⁷

	1972	1975	1980	1981	1982	1983
<u>Product data</u>						
Value of shipments (10 ⁶ \$)	6,295	8,247	13,012	14,623	16,691	18,980
Value of shipments (10 ⁶ 1982\$)	12,427	14,202	15,974	16,082	16,691	17,392
<u>Industry data</u>						
Total employment (10 ³ people)	112.0	123.0	135.0	131.0	124.0	124.0
Production workers (10 ³ people)	57.0	60.2	68.4	64.8	62.2	61.9
Capital expenditures (10 ⁶ \$)	167.0	321.0	675.0	729.0	861.0	834.0
Value added ^a (10 ⁶ \$)	5,640	6,923	11,048	12,059	13,484	NA
<u>Trade Data</u>						
Value of imports ^b (10 ⁶ \$)	14.5	33.9	61.6	52.6	40.7	141.0
Value of exports ^b (10 ⁶ \$)	182.0	270.0	421.0	532.0	563.0	670.0

NA = not available.

^aSource: Reference 38.

^bDeveloped by International Trade Administration.

forecast data for all pharmaceutical manufacturers classified under SIC code 2834. The data are presented in much the same manner as in Table 8-3, with a distinction between industry and product data.

As shown in Table 8-6, the value of pharmaceutical shipments increased steadily in the early 1980s in nominal and real terms. In contrast, industry employment during this same period exhibited a downward trend. Capital expenditures increased rapidly through 1982, but dropped slightly in 1983. While exports were steadily rising, imports fell in 1981 and again in 1982, but increased dramatically in 1983.

Table 8-7 contains some summary statistics on the sterilization chambers and sterilant gas used by the 40 pharmaceutical manufacturers included in this study. These 40 facilities operated a total of 84 sterilization chambers in 1986, averaging 2.1 per facility. The average chamber volume per facility for pharmaceutical manufacturers is 28.3 m³ (999 ft³), ranging from 0.1 m³ (4.9 ft³) to 147 m³ (5,200 ft³). Although the number of chambers per facility in the pharmaceuticals group roughly equals the number for the medical equipment suppliers group, the average chamber volume per facility for pharmaceutical manufacturers is about 70 percent of the average for medical equipment suppliers.

The pharmaceutical manufacturers used 532 Mg (588 tons) of EO in 1986, averaging 13.3 Mg (15 tons) per facility and varying from 0.01 Mg (.011 tons) per facility to 79.8 Mg (88 tons) per facility. They also used 949 Mg (1,049 tons) of total gas, with an average of 23.7 Mg (26 tons) per facility and a range of 0.1 (.07 tons) to 92.0 Mg (102 tons) per facility. The ranges of both EO use and total gas use are much narrower for pharmaceutical manufacturers than they are for medical equipment suppliers. Finally, the inert-gas ratio for pharmaceuticals is 0.8, compared to a 2.5 ratio for the medical equipment suppliers.

8.1.3.4 Spice Manufacturers. Twenty-four of the 191 facilities in this study have been categorized as spice manufacturers. These firms fall into five SIC codes: 2099, 5149, 2034, 2035, and 2046. However, as shown in Table 8-2, about two-thirds of these firms are in SIC code 2099. Consequently, we focus on this industry group in the discussion below.

TABLE 8-7. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 40 PHARMACEUTICAL MANUFACTURERS, 1986³⁹

	Average	Standard deviation	Range
Sterilization chambers = 84			
Number per facility	2.1	1.3	1 - 6
Chamber volume per facility (m ³)	28.3	35.1	0.1 - 147
Ethylene oxide use = 532 Mg/yr			
Use per facility (Mg/yr)	13.3	22.8	<0.05 - 79.8
Use per chamber volume (kg/m ³ /yr)	301	299	11.2 - 1,300
Total gas use = 949 Mg/yr			
Use per facility (Mg/yr)	23.7	28.7	0.1 - 92.0
Use per chamber volume (kg/m ³ /yr)	1,310	1,440	82.2 - 7,970

About one-quarter of all spices manufactured in the United States are treated with EO to control fungi, molds, bacteria and insect eggs.⁴⁰ Ethylene oxide pasteurization increases shelf life and decreases health risks.⁴¹ An industry magazine reports that "since the spice processor cannot preclude or remove microorganisms from spices, the only means to control microorganisms are: (1) to maintain low moisture content to hinder growth and activity and (2) to treat spices with EO."⁴²

Several substitutes within the spice industry are available for EO, each of which has disadvantages. Heat sterilization is useful on only a small number of spices, because it lightens or darkens spice color and can cause a 15 percent loss in spice strength by volatilizing spice oils. Neither ionizing radiation nor ethylene imine are approved by the FDA, and their effectiveness is not known. The use of propylene oxide is restricted by the FDA to starches, gums, processed spices, cocoa, and processed nut meats.⁴³ However, propylene oxide must be heated in order to be as effective as EO. The use of heat restricts its use to a small number of spices because heat volatilizes oils in spices, affecting their quality. Without heat, propylene oxide has one-tenth the microbial killing activity of EO. Finally, propylene oxide requires 16 to 48 hours of exposure time, compared with 6 to 8 hours for EO.

According to an industry source, radiation treatment is a promising alternative to EO fumigation, having several advantages over EO.⁴⁴ First, whereas EO kills a high percentage of bacteria, radiation kills all bacteria. Second, EO requires high humidity and a vacuum, while radiation treatment can be done under ambient conditions. Third, EO leaves a residue in all foods that have been treated, but radiation leaves no residues of any kind.

According to the Census Bureau, SIC 2099 had 1,976 firms in 1982.⁴⁵ As shown in Table 8-8, the value of shipments for SIC 2099 increased steadily from \$3.6 billion in 1972 to \$11.0 billion in 1982, a nominal growth of 201 percent over the 10-year period. Value added also increased steadily over the same period rising from \$1.8 billion in 1972 to \$5.7 billion in 1982. Employment experienced two low periods, one in the mid-1970s and another in the early 1980s. The number of production workers declined in

TABLE 8-8. RECENT PERFORMANCE DATA FOR SPICE MANUFACTURERS (SIC 2099) 46

	1972	1975	1977	1978	1979	1980	1981	1982
<u>Product data</u>								
Value of shipments (10 ⁶ \$)	3,647.9	5,583.8	6,531.0	7,360.6	7,568.9	8,536.5	9,598.9	10,979.3
<u>Industry data</u>								
Total employment (10 ³ people)	66.2	64.3	71.5	76.8	71.8	73.4	72.8	81.4
Production workers (10 ³ people)	44.7	44.2	50.9	55.8	52.3	51.7	52.3	57.9
Capital expenditures (10 ⁶ \$)	91.8	171.3	166.2	199.6	236.0	285.0	208.3	295.4
Value added (10 ⁶ \$)	1,805.2	2,431.3	3,028.1	3,487.8	3,493.8	4,038.0	4,569.6	5,663.3

1975 and again in 1979 and 1980, while total employment declined in 1979 and 1981. Both employment measures increased from 1981 to 1982. Capital expenditures increased from \$91.8 million in 1972 to \$295.4 in 1982 with declining years in 1977 and 1981.

The spice and seasoning industry relies heavily on foreign trade. According to one estimate, two-thirds of the spices consumed in the United States are imported.⁴⁷ This estimate includes some dehydrated vegetables that are used as seasonings but are not included in the FDA definition of spices.

The 24 firms in the spice manufacturers group that use E0 sterilization are distributed evenly across the country, except for a large concentration of seven firms in California. Table 8-9 shows some summary statistics on the sterilization chambers and sterilant gas used by these manufacturers. The 24 facilities operated a total of 29 sterilization chambers in 1986, an average of only 1.2 per facility. The number of chambers per facility ranged from one to four. Average chamber volume per facility was 27.0 m³ (954 ft³), which is much lower than the average for medical equipment suppliers, i.e., 41.8 m³ (1,476 ft³). In addition, the range of chamber volumes per facility, 0.1 m³ to 112 m³ (2.5 ft³ to 4,000 ft³), was much narrower for the spice manufacturers. Both average chamber volume per facility and the range of chamber volumes per facility for the spices group were roughly equal to the average and range for the pharmaceuticals group.

The spice manufacturers used 167 Mg (184 tons) of E0 and 545 Mg (603 tons) of total gas during 1986. Annual E0 use per facility averaged 6.9 Mg (8 tons) while total gas use per facility averaged 22.7 Mg (25 tons). Average total gas use per facility is roughly equal to average total gas use for the pharmaceuticals group, but average E0 use per facility is about half the average for pharmaceutical manufacturers. The inert-gas ratio for the spice manufacturers is 2.3, which is comparable to the 2.5 ratio for the medical equipment suppliers. This indicates that both industries rely on pure E0 processes to about the same extent.

8.1.3.5 Museums and Libraries. According to the 1982 Census of Services, there are 1,909 non-commercial museums and art galleries (SIC 8411) in the United States.⁴⁹ Additionally, there are 29,843 public and

TABLE 8-9. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 24 SPICE MANUFACTURERS, 1986⁴⁸

	Average	Standard deviation	Range
Sterilization chambers = 29			
Number per facility	1.2	0.6	1 - 4
Chamber volume per facility (m ³)	27.0	23.8	0.1 - 112
Ethylene oxide use = 167 Mg/yr			
Use per facility (Mg/yr)	6.9	12.3	<0.05 - 59.0
Use per chamber volume (kg/m ³ /yr)	257	373	4.5 - 1,610
Total gas use = 545 Mg/yr			
Use per facility (Mg/yr)	22.7	42.1	<0.05 - 200
Use per chamber volume (kg/m ³ /yr)	1,090	1,690	37.1 - 7,050

private libraries in the country.⁵⁰ The sterilization database contains eleven museums and two libraries. Interestingly, four of the thirteen are in Massachusetts and there are none in the Southeast or Northwest.

Museums and libraries fumigate books, documents, and other artifacts with E0 chiefly to control insect pests and mold. Museum experts report that E0 is "especially valuable for treatment of books and archival documents, furs, textiles, and furniture."⁵¹ However, E0 has one significant drawback as an artifact fumigant. It settles in rubber, leather, wood, and other organic materials, making it necessary for E0-fumigated artifacts to be aerated for up to a month before they are safe to handle.^{52,53}

It is recommended that all organic materials be fumigated before they are introduced into a museum or library collection.⁵⁴ Telephone conversations with museum and library conservators who use E0, however, revealed a range of fumigation criteria. Some conservators fumigate all new articles, while others fumigate only those articles that fail a visual inspection or that have suspect backgrounds--e.g., books that were kept in a damp basement.^{55,56}

Ethylene oxide has several substitutes as a fumigant in museum and library use. One promising substitute is sulfuryl fluoride, marketed under the trademark VIKANE. Sulfuryl fluoride is not absorbed by organic materials and dissipates more quickly than E0.⁵⁷ Therefore, it eliminates the need to aerate artifacts for long periods before handling. Furthermore, the cost of sulfuryl fluoride is comparable to the cost of 12/88, based upon current retail prices and the recommended doses of each sterilant.⁵⁸ Sulfuryl fluoride, however, is corrosive to metals, making it an unacceptable alternative for artifacts that contain metal. In particular, it could damage books with staple bindings.⁵⁹

Some E0 fumigation chambers would require modifications to use sulfuryl fluoride. Because sulfuryl fluoride is corrosive to metals, the vent pipes from the chamber must be stainless steel; installation of these new vent pipes would represent a startup capital cost for museums/libraries converting to sulfuryl fluoride use.⁶⁰

Sulfuryl fluoride is registered with the U.S. Department of Agriculture as a "restricted" pesticide and, therefore, can only be applied by a

certified applicator. Certified applicators must pass a test administered by the U.S. Department of Agriculture. Ethylene oxide is not registered as a "restricted" pesticide and can, therefore, be applied by anyone.⁶¹ The time and effort involved in passing the certified applicator test would represent another startup cost for museums/libraries converting to sulfuryl fluoride. Finally, sulfuryl fluoride is registered for use in fumigation chambers and there are no controls on its emissions.⁶²

Other alternatives to EO fumigation include deep freezing, carbon dioxide fumigation, and vacuum treatment. Several European institutions have tested the freezing method and reported that maintaining -18 °C (-0.4 °F) for 48 hours kills 100% of insect life in all stages of the life cycle. Freezers ranging from 0.9 to 1.1 m³ (30 to 40 ft³) in size have been most commonly used.⁶³ The necessary freezing apparatus costs approximately \$3,000-4,000.⁶⁴ Placing artifacts in a vacuum or fumigating them with carbon dioxide also kills insect life.^{65,66} These three methods, however, do not kill mold and fungi; therefore, they are only partial substitutes for EO.

Table 8-10 provides some summary statistics on the sterilization chambers and sterilant gas used by the 11 museums and two libraries included in this study. Each of these 13 facilities operated one sterilization chamber in 1986. These chambers averaged 2.60 m³ (91 ft³) in volume and ranged from 0.5 to 13.8 m³ (18 to 486 ft³). The average chamber volume per facility for this group is roughly one-twentieth the average chamber volume per facility for the medical equipment suppliers. Additionally, all of the gas use figures are much lower than the figures for medical equipment suppliers.

During 1986, the museums and libraries group used a total of 0.20 Mg (.22 tons) of EO and 1.67 Mg (1.85 tons) of total gas. Medical equipment suppliers used over 4,000 times as much EO and over 1,800 times as much total gas as the museums and libraries group. In addition, gas use per cubic meter of chamber volume was much lower for this group than for any other group. Medical equipment suppliers used fourteen times as much total gas and twenty-two times as much EO per cubic meter of chamber volume as the museums and libraries group. Furthermore, this group used substan-

TABLE 8-10. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 13 MUSEUMS AND LIBRARIES, 1986⁶⁷

	Average	Standard deviation	Range
Sterilization chambers = 13			
Number per facility	1.0	0.0	1 - 1
Chamber volume per facility (m ³)	2.6	3.7	0.5 - 13.8
Ethylene oxide use = 0.20 Mg/yr			
Use per facility (Mg/yr)	0.0	0.0	0.0 - 1.0
Use per chamber volume (kg/m ³ /yr)	12.6	17.9	0.9 - 57.0
Total gas use = 1.67 Mg/yr			
Use per facility (Mg/yr)	0.1	0.1	0.0 - 0.4
Use per chamber volume (kg/m ³ /yr)	105	149	7.6 - 472

tially less EO per cubic meter of chamber volume than any other industry group in this study, i.e., 12.6 kg/m³/yr (.78 lb/ft³/yr) while all other industry groups used over 200 kg/m³/yr (12.5 lb/ft³/yr). The inert-gas ratio for the museums and libraries group was 7.35, which suggests that facilities in this group used 12/88 exclusively.

8.1.3.6 Laboratories. Four of the firms being considered for regulation are commercial laboratory rat and mice breeders, which are classified in SIC code 0279. Animal breeders use EO to sterilize heat-sensitive plastics, heat/water-sensitive electronic lab equipment, and pre-packaged articles required for breeding. These articles include books, phones, optical equipment, meters, microscopes, and face masks.⁶⁸

There are some alternatives to EO sterilization for laboratory animal breeding, although each has disadvantages. Pressurized steam damages plastics, electronic equipment and other heat/water-sensitive materials. In addition, steam does not permeate pre-packaged materials as effectively as EO. Dry heat degrades those heat-sensitive materials that cannot withstand temperatures of 160-165 °C (320-329 °F). Another alternative, peracetic acid, is not registered as a pesticide, and is considered to be carcinogenic. It is also corrosive to most metals and plastics, and has poor penetrating properties. Glutaraldehyde requires at least 10 hours immersion, and cannot be used with prepackaged materials. It poses a recontamination danger from hand manipulations and air and cannot be used for materials that would be damaged by water.⁶⁹

Two noncommercial research organizations, SIC code 8922, have also been identified as operators of sterilization chambers. These firms use EO in the same manner as the lab animal breeders mentioned above, but on a somewhat more limited scale. EO alternatives and disadvantages mentioned for animal breeders also apply here.⁷⁰

The remaining facilities classified as laboratories are two research and development labs (SIC code 7391), two medical labs (SIC code 8071), and one commercial testing lab (SIC code 7397). These five firms are considered together because their sterilization practices are similar. In particular, these facilities investigate whether medical devices can be effectively sterilized and yet still function within the human body. There are

limited alternatives to E0 for these facilities; E0 must be used for heat- and moisture-sensitive medical devices and drugs.⁷¹

Table 8-11 reports some summary statistics on the sterilization chambers and sterilant gas used by the 11 laboratories included in this study. These facilities operated 30 E0 sterilization chambers during 1986, an average of 2.7 per facility. The number of chambers per facility ranged from one to eight. Average chamber volume per facility was 14.7 m³ (520 ft³), but varied from 0.02 to 120 m³ (.7 to 4,230 ft³) per facility. The laboratories group averaged about the same number of chambers per facility as the medical equipment suppliers group; however, the laboratories group had a lower average chamber volume per facility than all other groups (except the museums and libraries group). This suggests that the laboratory group operated smaller chambers than the other groups (except the museums and libraries group).

The laboratory group used 70.6 Mg (77.4 tons) of E0 and 139 Mg (154 tons) of total gas during 1986. The group average of 6.4 Mg (7.1 tons) of E0 per facility is roughly equal to the spice manufacturer's use per facility, while less than all other groups (excluding museums and libraries). The laboratories also used less total gas per facility, 12.6 Mg/yr (14.0 tons), than all other groups excluding museums and libraries. The standard deviations for chamber size per facility, E0 use per facility, and total gas use per facility were relatively high compared to their respective averages. This is not surprising since the laboratories group is more heterogeneous than the other groups in the study. The inert-gas ratio for the laboratory group was 1.0, implying that the laboratories rely heavily on pure E0.

8.1.3.7 Contract Sterilizers. As mentioned earlier, there is a subset of sterilization facilities that sterilize products on a contract basis. These contract facilities are normally classified under SIC 7399 (Business services, not elsewhere classified). However, depending on the main type of product sterilized, the facility may fall under another related category. For example, one contract sterilizer works with surgical garments and is classified under SIC 7218 (Industrial launderers). In addition to the facilities whose primary function is contract steriliza-

TABLE 8-11. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 11 LABORATORIES, 1986⁷²

	Average	Standard deviation	Range
Sterilization chambers = 30			
Number per facility	2.7	2.3	1 - 8
Chamber volume per facility (m ³)	14.7	33.6	<0.05 - 119.9
Ethylene oxide use = 70.6 Mg/yr			
Use per facility (Mg/yr)	6.4	17.5	<0.05 - 61.1
Use per chamber volume (kg/m ³ /yr)	143	184	6.3 - 539
Total gas use = 139 Mg/yr			
Use per facility (Mg/yr)	12.6	25.8	<0.05 - 72.2
Use per chamber volume (kg/m ³ /yr)	800.0	1,220	51.5 - 4,490

tion, there are several facilities classified under a different category who sometimes accept contract work. These are especially prevalent within the medical equipment industry.

There are varying reports as to the number of contract sterilizers in the United States. One official at the FDA estimated that there are 100 to 125 contract sterilizers of all types, i.e., EO, steam, radiation, etc. Of these, approximately 60 are EO sterilizers.⁷³ Another source at the FDA estimated that there are 65 contract sterilizers of medical equipment, 18 of which do contract work only.⁷⁴ Only 16 of the 191 facilities in this study have been identified as contract sterilizers exclusively; however, an undetermined number of the other facilities also accept contract work.

The price for contract sterilization varies with the type of sterilization performed. An industry spokesman at a contract sterilization facility estimated that the average price for pure EO sterilization is currently \$32/m³ (\$0.90/ft³) of product.⁷⁵ Sterilization with 12/88 at a similar facility is estimated to average about \$48/m³ (\$1.35/ft³) of product. The difference in price between sterilization with pure EO and 12/88 is due to the increased amount of gas necessary to sterilize with 12/88.⁷⁶ In spite of the higher cost, facilities use the 12/88 formulation because some products or packaging cannot withstand sterilization with pure EO, as noted previously. In addition, pure EO is explosive, making worker safety a concern.

One expert on sterilization has predicted 30 percent growth in the next 5 years for contract sterilizers.⁷⁷ Growth would then continue at a rate of 4 to 5 percent annually. Implicit in this projection is the assumption of no additional Federal regulations in the future. Any new regulations would probably augment the positive growth of contract sterilization, because it is possible that smaller facilities would cease in-house sterilization operations and begin sending products off-site.* However, this trend may not be as great on the western coast of the United States. Currently, there are an inadequate number of contract sterilizers

*See Section 8.2.1 for further discussion of the possible substitution of contract sterilization for in-house sterilization due to the candidate NESHAP controls on EO emissions.

in that region to meet the needs of all the medical equipment suppliers and food distributors.⁷⁹ Presumably, larger facilities or facilities that sterilize a large volume of products will be able to install the control devices with less economic impact.

Table 8-12 contains some summary statistics on the sterilization chambers and sterilant gas used by the 16 contract sterilizers included in this study. These 16 facilities operated 48 EO sterilization chambers in 1986--an average of exactly 3 per facility, which is more than any other group in the study. The contract sterilizers also had more chamber volume than any other group, averaging 70.8 m³ (2,500 ft³) per facility. During 1986, the contract sterilizers used 375 Mg (414 tons) of EO and 1,700 Mg (1,880 tons) of total gas--approximately half the amounts used by the medical equipment suppliers. However, the contract sterilizers used much more EO and total gas than any other group on a per-facility and per-cubic-meter-of-chamber-volume basis. The inert-gas ratio for contract sterilizers was 4.4, indicating that contract sterilizers fall in the middle of the industry groups regarding their reliance on pure EO. This is not surprising since contract sterilizers service diverse industries with varying sterilization requirements.

8.2 ECONOMIC EFFECTS OF CANDIDATE NESHAP CONTROLS

In this section we analyze the economic effects that the candidate NESHAP controls will have on sterilization facilities. Section 8.2.1 briefly reviews the ideal conceptual framework for such an analysis. Section 8.2.2 describes the analytical procedure we used as a proxy for the ideal conceptual framework. Section 8.2.3 presents the empirical results of the economic analysis. Finally, Section 8.2.4 contains our conclusions based upon these empirical results.

8.2.1 Ideal Conceptual Framework

The ideal procedures for estimating the economic effects of the proposed NESHAP controls are based upon a demand-supply conceptual framework.* A market demand curve describes the maximum quantity (per time

*For a detailed description of this conceptual framework, see Chapter 2 in Reference 81.

TABLE 8-12. SUMMARY STATISTICS ON STERILIZATION CHAMBERS AND GASES
USED BY 16 CONTRACT STERILIZERS, 1986⁸⁰

	Average	Standard deviation	Range
Sterilization chambers = 48			
Number per facility	3.0	2.5	1 - 9
Chamber volume per facility (m ³)	70.8	67.9	13.8 - 278
Ethylene oxide use = 375 Mg/yr			
Use per facility (Mg/yr)	23.4	27.3	1.5 - 108
Use per chamber volume (kg/m ³ /yr)	325	256	80.4 - 951
Total gas use = 1,701.2 Mg/yr			
Use per facility (Mg/yr)	106.3	117.6	12.3 - 442.9
Use per chamber volume (kg/m ³ /yr)	1,720	1,310	146.9 - 4,800

period) of a commodity, Q , that individuals or firms are willing to purchase at various prices, *ceterus paribus* (all else equal). As shown in Figure 8-2, demand curves are downward sloping, indicating that consumers are willing to buy more of Q at lower prices than at higher prices. This assumes that all other factors that might influence demand--for example, income, prices of related goods, and tastes or preferences--do not change.

If the market process establishes a price of P_1 , consumers will purchase Q_1 of the commodity for a total expenditure equal to OP_1BQ_1 . Since a demand curve measures maximum willingness to pay for each unit of a commodity, the total willingness to pay for Q_1 is the entire area $OABQ_1$ --total expenditures plus the triangle P_1AB . This triangle, which is the difference between what consumers actually pay and the amount they are willing to pay, is known as consumer surplus. It is a good empirical approximation of the dollar value of the well-being consumers receive from consuming a commodity, over and above what they pay for the commodity.

The other principal construct in our conceptual framework is a market supply curve. A supply curve shows the maximum output (per time period) of a commodity that firms are willing to supply at various prices, *ceterus paribus*. The upward slope of supply curves (as shown in Figure 8-3) indicates that firms are willing to produce more at higher prices than at lower prices, assuming that other factors influencing the supply curve-- prices of inputs (such as labor, energy, and machinery) and production technology--do not change.

If the market process establishes a price of P_1 , then suppliers will produce Q_1 units of the commodity, receiving OP_1BQ_1 in total revenues. However, the cost of producing these Q_1 units is represented by the area $OCBQ_1$. The triangle CP_1B , which is known as producer surplus, is the difference between the minimum amount firms would accept for the Q_1 units and the actual amount they receive for these units. Producer surplus is a good empirical approximation of the dollar value of the returns that firms experience from producing a commodity, over and above the costs of production.

Installing and operating controls on E0 emissions from sterilization chambers will increase the cost of producing sterilized products. In a demand-supply framework, this additional cost is represented by an upward

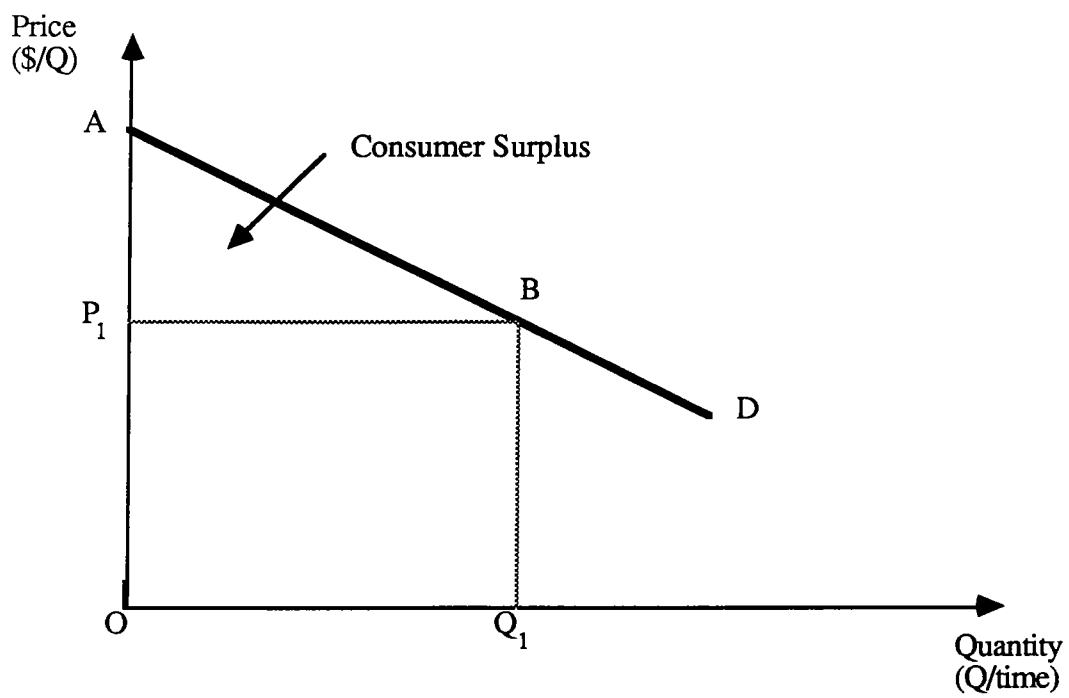


Figure 8-2. Demand curve for commodity Q.

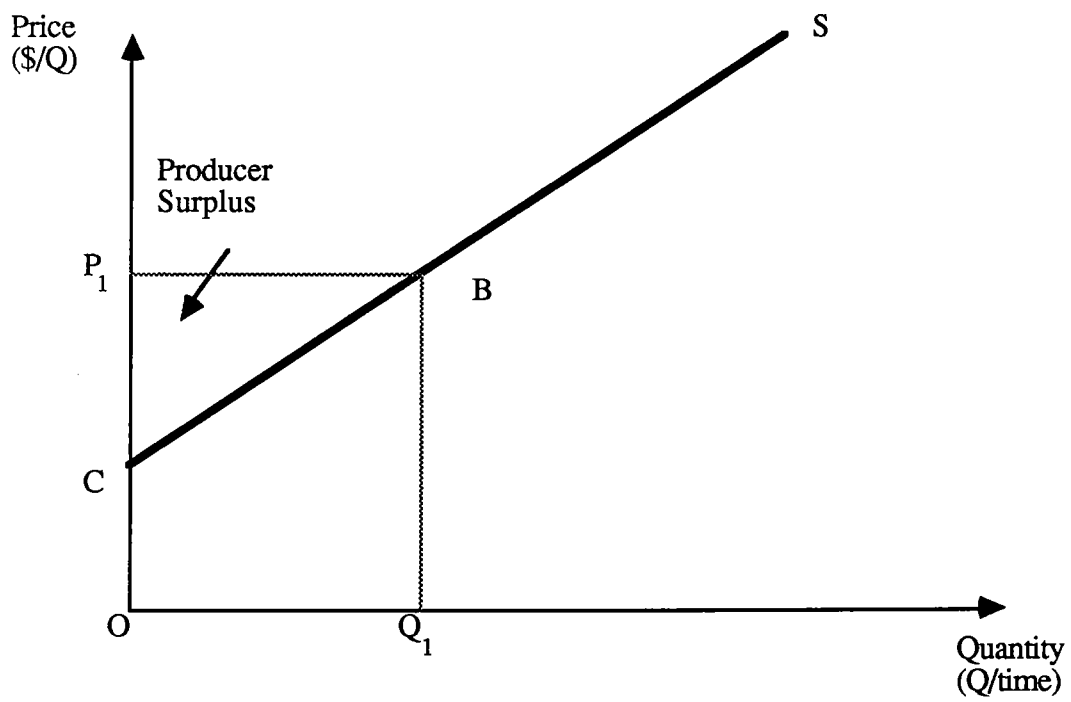


Figure 8-3. Supply curve for commodity Q.

shift in the supply curve (from S to S' in Figure 8-4). This upward shift in the supply curve leads to a higher market price (P_1') and smaller quantity demanded (Q_1'). The changes in price (from P_1 to P_1') and quantity (from Q_1 to Q_1') are the market adjustments attributable to the emissions controls.

The cost of this change in market-clearing price and quantity due to the emissions controls is represented by the area CDEB--the area between the two supply curves S and S' and under the demand curve. This area, which constitutes the cost that society experiences due to the emissions controls, equals the sum of the additional cost of producing Q_1' units of the commodity (area CDEF) plus the foregone consumer and producer surplus on the $(Q_1 - Q_1')$ units of the commodity that are no longer produced or consumed (area EFB). Equivalently, the social cost of emissions controls can be determined by aggregating the impact of the controls on the well-being of consumers and producers of affected commodities. In other words, social cost equals the sum of the change in consumer and producer surplus as a result of the price-quantity adjustments.

The simple model in Figure 8-4 ignores two potentially important aspects of the economic impact of the candidate NESHAP controls. First, the controls will apply to both existing and new plants (when they are constructed) that produce sterilized products. Thus, there are two relevant supply curves--a supply curve from existing plants and a supply curve from new plants. The candidate NESHAP controls will shift both of these supply curves upward, although the magnitude of these shifts will probably differ. The potential effects of the candidate NESHAP controls on new facilities are addressed in Section 8.2.4.2.

Second, the candidate NESHAP controls will probably cause some firms to substitute "contract" sterilization for "in-house" sterilization. In-house sterilization refers to sterilization performed onsite by a firm as part of the production process, while contract sterilization refers to sterilization performed offsite under contract. If the candidate NESHAP controls are promulgated, facilities using the EO sterilization process will face four possible alternatives:

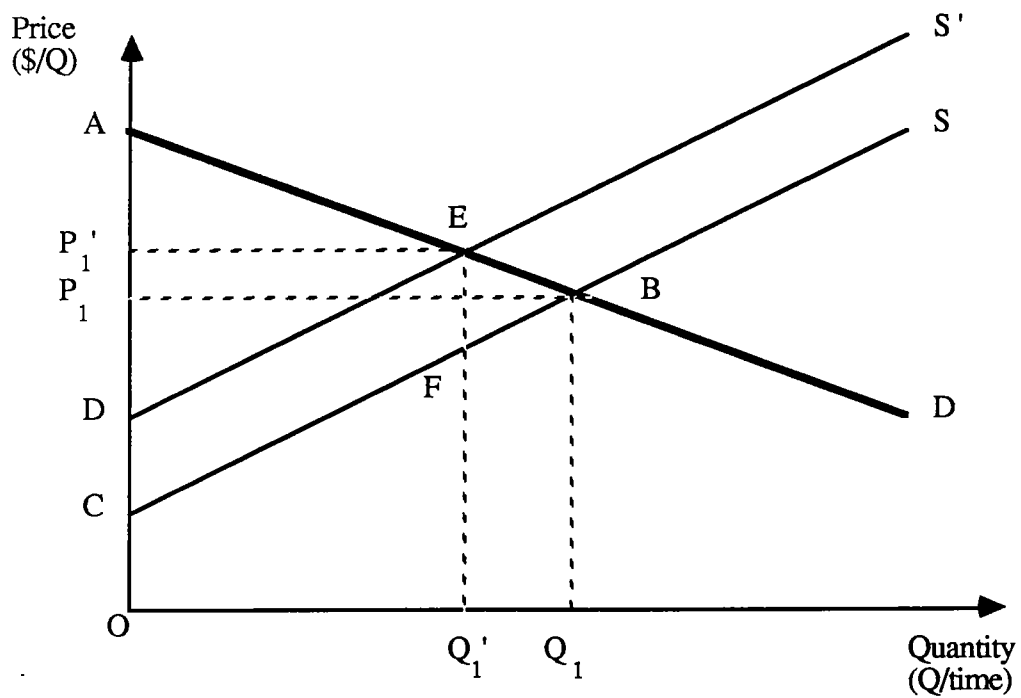


Figure 8-4. Market equilibrium with and without an upward shift in the supply curve due to ethylene oxide emissions controls.

1. adopt the candidate controls,
2. switch to another sterilization process,
3. discontinue in-house sterilization, switching to contract sterilization, or
4. discontinue production of the sterilized product.

Undoubtedly, the substitution of contract sterilization for in-house sterilization (alternative 3) will be the least-cost alternative for some facilities. Due to a lack of needed data, no quantitative estimates of the extent of this substitution are made.*

8.2.2 Analytical Procedure

The ideal conceptual framework involves the market price and quantity sold of a single product. In this study, however, we are not modeling a single product; the candidate NESHAP covers a broad range of products produced by a number of different industries. Therefore, we cannot draw a single supply or demand curve for sterilized products. Consequently, we cannot use the ideal conceptual framework to analyze the economic effects of the candidate commercial sterilization NESHAP. As an alternative, we use a more qualitative approach that approximates the ideal approach.

Our approach has four parts. First, we impose some homogeneity by dividing commercial sterilizers into seven industry groups. Second, we use each facility's chamber volume and annual EO use as proxies for the quantity of goods produced. By dividing these proxies into the annual compliance cost, we obtain rough estimates of the per-unit production cost increase caused by the candidate NESHAP. Third, we divide each facility's annual compliance cost by its total cost of sterilization to obtain an upper bound for the percentage increase in production cost caused by the NESHAP. Finally, we divide each facility's annual compliance cost by its total sales to obtain a lower bound estimate of the percentage production cost increase. Each facility's actual percentage production cost increase attributable to the candidate NESHAP will lie somewhere between its upper and lower bound.

8.2.2.1 Industry Grouping. As discussed above, we have divided the 191 affected facilities into seven industry groups based on their SIC code

*For a detailed explanation of the substitution effect, see Appendix G.

classifications: medical equipment suppliers, other health-related suppliers, pharmaceuticals manufacturers, spice manufacturers, museums and libraries, laboratories, and contract sterilizers. The firms within each of these sub-groups produce a more homogeneous mix of goods than the aggregate group. Nevertheless, the product mix is still quite diverse within the industry groups, as demonstrated in Section 8.1.

8.2.2.2 Chamber Volume as an Output Measure. The sum of the volumes of all sterilization chambers at a facility can be viewed as a measure of the facility's sterilization capacity. If we assume that sterilization cycles for all sizes and types of chambers are of equal duration, then a facility with twice the chamber volume of another facility will also have twice the sterilization capacity. If this assumption is not true, then the direct relationship will not hold. For example, if larger chambers undergo longer cycles, then chamber volume will overstate sterilization capacity for large chambers and understate capacity for small chambers. If small chambers undergo longer cycles, then the reverse will hold.

With two additional assumptions, chamber volume can be used not only as a measure of capacity, but also as a measure of output. First, we assume that all facilities within an industry group perform about the same number of sterilization cycles per year. Second, we assume that the sterilization chambers are always filled with products to approximately the same level. Under these assumptions, chamber volume would be highly correlated with the volume of goods sterilized.

How valid are these two assumptions? Data from the EPA commercial sterilization database indicate that facilities do not perform equal numbers of sterilization cycles per chamber, even within industry groups.⁸² For example, in the medical equipment suppliers group, the number of sterilization cycles per chamber per year varies from 15 to over 1,000. The remaining six industry groups exhibit a similar variation. This indicates that our first assumption is not true. Therefore, chamber volume may be a poor output measure.

8.2.2.3 E0 Use as a Measure of Output. E0 use is our second surrogate output measure. The EPA commercial sterilization database provides data on the amount of E0 used per facility during 1986 (1985 for some

facilities).⁸³ EO use is a better output measure than chamber volume because EO use will vary directly with the volume of goods sterilized, even if firms do not run a consistent number of sterilization cycles per chamber. We make two assumptions, however, when using EO as a measure of the volume of products sterilized. First, we assume that the concentration of EO per unit of chamber volume will be roughly the same for all chambers. Second, we assume that sterilization chambers will be filled with products to roughly the same level for each cycle.

Although we have no supporting data, we can speculate that sterilization chambers may not always be filled with products to the same level. It seems probable that facilities running frequent sterilization cycles would always fill their chambers to capacity in order to minimize costs. However, facilities that sterilize infrequently may run some cycles at less than capacity, as they face sporadic orders for sterilized goods and shipment deadlines. To the extent that this occurs, EO use may overstate the volume of goods sterilized by small-volume sterilizers. If the small-volume sterilizers are also high per-unit-cost producers (i.e., marginal facilities), then the overstatement of their output would make the industry supply curve appear flatter (i.e., more elastic) than it actually is.

To this point, we have ignored a potentially important problem with our output measures. As mentioned above, a broad range of products are sterilized with EO. Chamber volume and EO use are measures of the physical volume of products sterilized, but with such a diverse group of products, volume is not a wholly appropriate measure of output. For example, one facility may sterilize pacemakers while another sterilizes scalpels. It seems likely that output (in physical or monetary units) per cubic meter of chamber volume would differ substantially between pacemakers and scalpels. A similar conclusion seems reasonable regarding EO use as an output measure. In summary, the large number of products sterilized in the seven industry groups undermines the usefulness of chamber volume and EO use as proxies for facility output.

8.2.2.4 Cost of Sterilization. In light of the pacemaker-scalpel problem described above, we report TAC not only on a per-unit-of-output basis as described above, but also on a percentage-of-cost basis. Ideally,

we would report TAC as a percentage of the total cost of producing sterilized products. However, no data on such costs at the affected facilities are available. Therefore, we report TAC as a percentage of the total annualized cost of sterilization at a facility (TAC/CS) and TAC as a percentage of total facility sales (TAC/S). Because the total cost of producing sterilized products (hereafter referred to as total production cost) will equal or exceed sterilization cost for any facility, TAC/CS is an upper bound for TAC/total production cost. Conversely, total production cost will generally be less than or equal to facility sales, particularly since most affected facilities produce a mix of sterilized and unsterilized products. Therefore, TAC/S will be a lower bound for TAC/total production cost.

We calculated the total annual cost of sterilization for each facility using a model chamber approach. Specifically, we calculated the capital cost and operating cost per cycle for representative sized chambers in the following chamber categories: 12/88, Pure EO, Non-Flammable EO/CO₂, and Flammable EO/CO₂. We picked four representative chamber sizes for the 12/88 gas-type, four for pure EO, three for flammable EO/CO₂ and two for non-flammable EO/CO₂. We selected representative chamber sizes by first minimizing the total variance between the representative chamber sizes and the sizes of chambers currently in use, as reported in the EPA Commercial Sterilization Database. Then we finalized our selection of representative chamber sizes by reviewing scatter plots of actual chamber sizes and talking with a vendor of sterilization chambers.

A sterilization chamber vendor provided estimates of capital and operating costs for each model chamber. Capital costs include the cost of the sterilization chamber, the cost of chamber installation, and the cost of explosion protection equipment for use with flammable sterilant gases. Chamber operating costs include labor, electricity, and sterilant gas costs.

Once we determined the capital and operating costs for the model chambers, we divided the chambers at the affected facilities into the four gas types outlined above. We then determined the operating cost per cycle and capital cost for each chamber by interpolating between the model chambers based on chamber size. We multiplied the operating cost per cycle

by the annual number of cycles for the chamber, as reported in the EPA Commercial Sterilization Database, obtaining the annual operating cost of the chamber. We annualized the capital cost using a useful life of 10 years and an interest rate of 10 percent and added the annualized capital cost and the annual operating cost to obtain the annual sterilization cost for the chamber. As a final step, we aggregated annual sterilization costs for individual chambers at each facility to determine the total annual cost of sterilization at the facility.

8.2.2.5 Facility Sales. Total facility sales provide an upper-bound estimate of the total costs of producing sterilized goods for several reasons. First, total sales for a facility include sales of sterilized and unsterilized products. For facilities that sterilize only a small portion of output, total sales may substantially exceed sales of sterilized products. Second, sales reflect the price of final products multiplied by the output of these products. They do not directly measure production costs. In general, sales equal production costs plus producer surplus. Producer surplus is only zero when the supply curve is horizontal or the firm is the marginal firm in its industry; therefore, using sales to measure production costs implies one of these two conditions. If producer surplus is not zero, then total sales will overstate total production costs.

As noted, we report sales on a facility-specific basis. When a facility did not report its own sales and the parent company sales were available, the amount of sales per employee for the parent company was multiplied by the number of employees at the facility to estimate sales at the facility. This assumes that the amount of sales per employee at the parent and the facility are the same, which would not be true, for example, if the facility were more capital-intensive than the parent company. We have no information regarding the validity of this assumption.

Where no sales or employment information was available, we used an ordinary-least-squares regression of facility sales on facility EO use to estimate facility sales. Dummy variables were included to represent the seven industry groups, and a log-log functional form was used.

8.2.3 Results

As explained in the previous section, we base our economic analysis on the annual cost of compliance with the candidate NESHAP controls relative to chamber volume, EO use, total sterilization costs, and total sales. We present the summary statistics on these values in this section.

8.2.3.1 Total Annualized Cost. Total annualized cost measures the annual engineering cost of compliance with the candidate NESHAP controls. As explained in Chapter 8, total annualized cost equals the capital cost of an acid-water scrubber and other necessary hardware annualized over a 10-year period at an interest rate of 10 percent, plus annual operating costs for the scrubber, including labor, materials, and ethylene glycol disposal costs. Electric and water costs for scrubber operation are assumed to be insignificant and are not included.

Table 8-13 reports the median and range of total annualized cost (TAC) per facility for each of the seven industry groups. Contract sterilizers have the highest median TAC at \$46,900 per facility. The lowest median TAC is \$21,100 per facility for the museums and libraries group. TAC per facility ranges from a low of \$1,000 for one of the pharmaceutical manufacturers to a high of \$117,000 for a medical equipment supplier. The medical equipment suppliers group exhibits the largest range in TAC values, while the museums and libraries group has the smallest TAC range.

8.2.3.2 TAC Relative to Chamber Volume. Table 8-14 reports the median and range of TAC per cubic meter of chamber volume per facility (TAC/CV). Applying the descriptions and assumptions discussed previously, TAC/CV reflects the cost increase per unit of sterilization capacity that the candidate NESHAP will cause. Museums/libraries have the highest median TAC/CV (\$20,700) while laboratories have the second highest (\$12,100). All other median TAC/CV are below \$2,500, with contract sterilizers the lowest at \$1,260.

The laboratory group has the highest upper range value of TAC/CV (\$1,230,000). Facilities with the highest TAC/CV values are most likely to close or cease in-house-sterilization in response to the candidate NESHAP. The lowest TAC/CV value for most of the industry groups is under \$100. However, the lowest TAC/CV value for the museums and libraries group is

TABLE 8-13. SELECTED SUMMARY STATISTICS ON THE TOTAL ANNUALIZED
COST OF THE CANDIDATE NESHAP CONTROLS PER FACILITY, 1986⁸⁴

Industry group	Median (\$)	Range (\$)
Medical equipment suppliers	26,600	1,300 - 117,000
Other health-related suppliers	29,300	2,500 - 70,400
Pharmaceutical manufacturers	23,400	1,000 - 98,600
Spice manufacturers	34,300	7,700 - 65,200
Museums and libraries	21,100	21,100 - 27,800
Laboratories	24,000	21,100 - 81,900
Contract sterilizers	46,900	8,000 - 105,000

TABLE 8-14. SELECTED SUMMARY STATISTICS ON THE TOTAL
ANNUALIZED COST OF THE CANDIDATE NESHAP CONTROLS PER
CUBIC METER OF CHAMBER VOLUME PER FACILITY, 1986⁸⁵

Industry group	Median (\$/m ³)	Range (\$/m ³)
Medical equipment suppliers	1,830	17 - 93,200
Other health-related suppliers	1,280	46 - 53,200
Pharmaceutical manufacturers	2,430	13 - 149,000
Spice manufacturers	1,900	69 - 281,000
Museums and libraries	20,700	2,000 - 41,400
Laboratories	12,100	683 - 1,230,000
Contract sterilizers	1,260	29 - 2,430

\$2,000, which almost equals the highest TAC/CV in the contract sterilizers group. This suggests that control costs will be relatively high for all museums and libraries having sterilization chambers. This conclusion is supported by the large median value of TAC/CV for this group.

8.2.3.3 TAC Relative to EO Use. Table 8-15 reports median and range values of the total annualized cost per kilogram of EO used per facility (TAC/EO). TAC/EO reflects the per-unit production cost increase caused by the candidate NESHAP. Museums and libraries have the highest median TAC/EO (\$2,620), which is over ten times the second highest median (i.e., \$237 for laboratories). As noted above, museums/libraries and laboratories also have the highest medians of TAC/CV. The median values of TAC/EO for the remaining five industry groups are below \$20, with contract sterilizers having the lowest median value at \$4.

The lowest facility TAC/EO value for six of the industry groups is \$1 or less. In contrast, the lowest TAC/EO value for museums and libraries is \$462. This group also has the highest TAC/EO value at \$31,000. In contrast, the highest TAC/EO for contract sterilizers is \$20.

8.2.3.4 TAC Relative to Annual Sterilization Cost. Table 8-16 reports the median and range values of total annualized cost per dollar of annual sterilization cost per facility (TAC/CS). As previously indicated, TAC/CS provides an upper bound for TAC as a percentage of total production cost, which is the desired measure. Table 8-16 shows that the museums/libraries group has the largest median TAC/CS at 109 percent. So the candidate NESHAP controls will more than double the cost of sterilization at the median facilities in this group. The laboratories and spices groups have the second and third highest median values with 56.7 percent and 37.0 percent, respectively. The contract sterilizers group has the lowest TAC/CS at 9.3 percent. The low median value for this group supports the hypothesis that contract sterilizers may experience economies of scale in controlling ethylene oxide emissions. In other words, the candidate NESHAP controls may cause lower per-unit increases in production costs for contract sterilizers than for the other groups.

To further investigate the distribution of TAC/CS among the facilities in the seven industry groups, we developed scatter plots of TAC/CS versus

TABLE 8-15. SELECTED SUMMARY STATISTICS ON THE TOTAL ANNUALIZED
COST OF THE CANDIDATE NESHAP CONTROLS PER KILOGRAM
OF EO USED PER FACILITY, 1986⁸⁶

Industry group	Median (\$/kg)	Range (\$/kg)
Medical equipment suppliers	7	<0.5 - 3,880
Other health-related suppliers	8	<0.5 - 9,770
Pharmaceutical manufacturers	13	<0.5 - 2,770
Spice manufacturers	20	<0.5 - 5,210
Museums and libraries	2,620	462 - 31,000
Laboratories	237	1 - 7,750
Contract sterilizers	4	<0.5 - 20

TABLE 8-16. SELECTED SUMMARY STATISTICS ON THE TOTAL ANNUALIZED
COST OF THE CANDIDATE NESHAP CONTROLS AS A PERCENTAGE OF THE
ANNUAL COST OF STERILIZATION PER FACILITY, 1986

Industry group	Median (%)	Range (%)
Medical equipment suppliers	14.5	<0.5 - 118
Other health-related suppliers	12.4	<0.5 - 114
Pharmaceutical manufacturers	23.9	<0.5 - 218
Spice manufacturers	37.0	0.6 - 113
Museums and libraries	109	28.9 - 127
Laboratories	56.7	3.0 - 122
Contract sterilizers	9.3	<0.5 - 45.4

annual sterilization costs for each industry group (see Figures 8-5 through 8-11). In general, these plots depict a hyperbolic shape. In other words, TAC/CS decreases asymptotically as sterilization cost increases. These plots also display the magnitude of TAC/CS for individual facilities within the range of values shown in Table 8-16.

8.2.3.5 TAC Relative to Total Sales. Table 8-17 contains the median and range values of total annualized cost per dollar of facility sales (TAC/S). This measure is a lower bound for TAC as a percentage of total production cost. Therefore, a low TAC/S does not necessarily imply that the candidate NESHAP controls will cause a small rise in total production costs, or that firms in an industry group will adopt the controls and continue in-house sterilization operations. The latter point is discussed further in Section 8.2.4.1.

Contract sterilizers have the highest median TAC/S at 4.24 percent, with the museums and libraries group nearly equal at 4.22 percent. For the other five industry groups, the median TAC/S does not exceed 0.33 percent. High upper range values of TAC/S include 17.1 percent for a contract sterilization facility, 12.9 percent for a museum/library, and 10.1 percent for a pharmaceuticals manufacturing facility. Figures 8-12 through 8-18 show the distribution of TAC/S among the facilities in each industry group. These scatter plots depict the same hyperbolic shape found in the TAC/CS scatter plots - TAC/S decreases asymptotically as total sales increase.

8.2.4 Conclusions

In this section we summarize our conclusions regarding the economic effects of the candidate NESHAP controls on existing and new facilities.

8.2.4.1 Effects on Existing Facilities. Based on the median values reported in Section 8.2.3, we expect the candidate NESHAP to notably affect only two industry groups: museums/libraries and contract sterilizers. The candidate NESHAP will have a significant effect on all facilities in the museums/libraries group. These facilities have very small chambers and use a very small quantity of EO. Consequently, the TAC/CV and TAC/EO values for museums and libraries are relatively high. The TAC/CS values indicate that the candidate NESHAP controls will more than double sterilization costs for many museums and libraries.

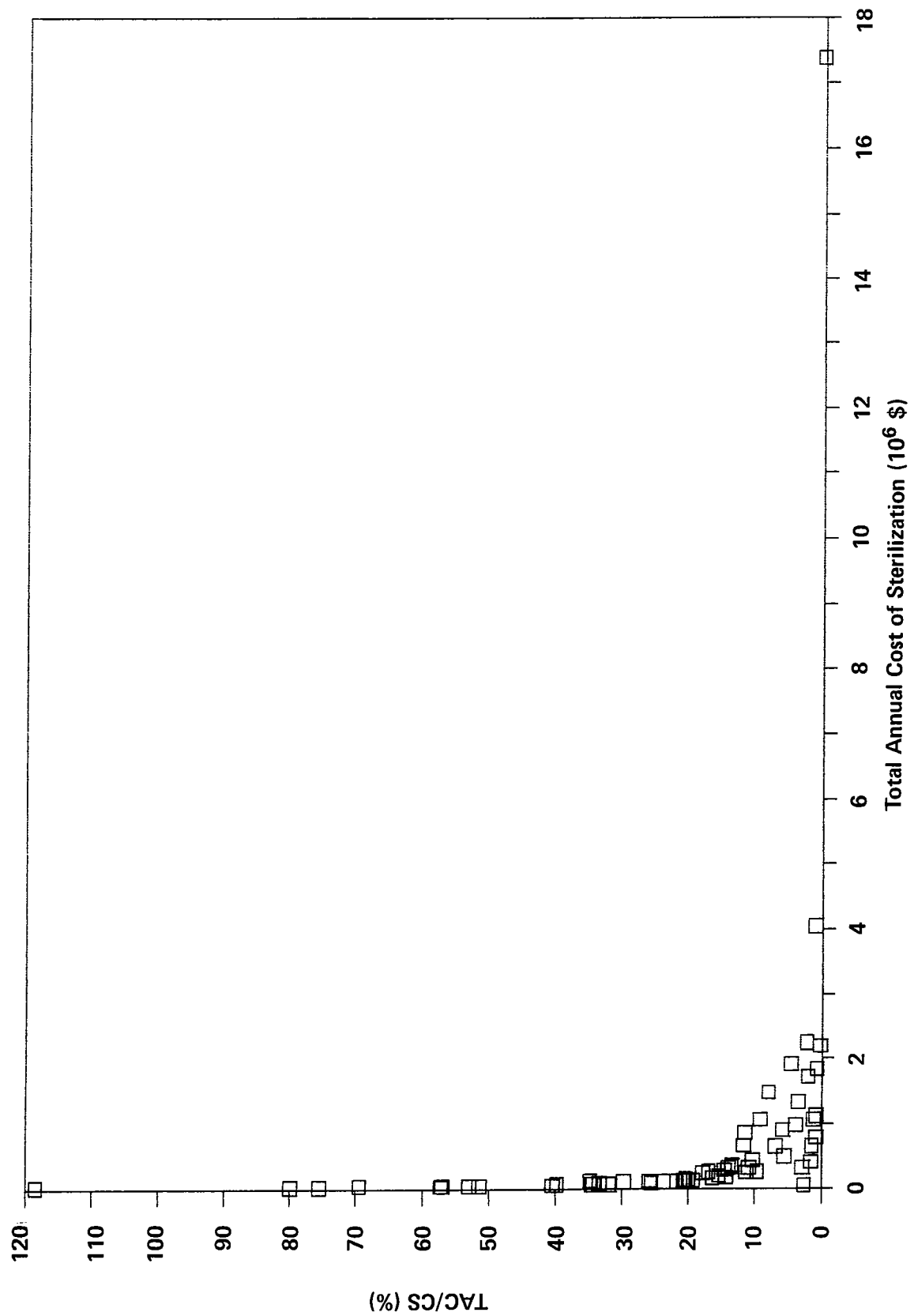


Figure 8-5. Scatter plot of TAC/CS and total annual cost of sterilization for medical equipment suppliers.

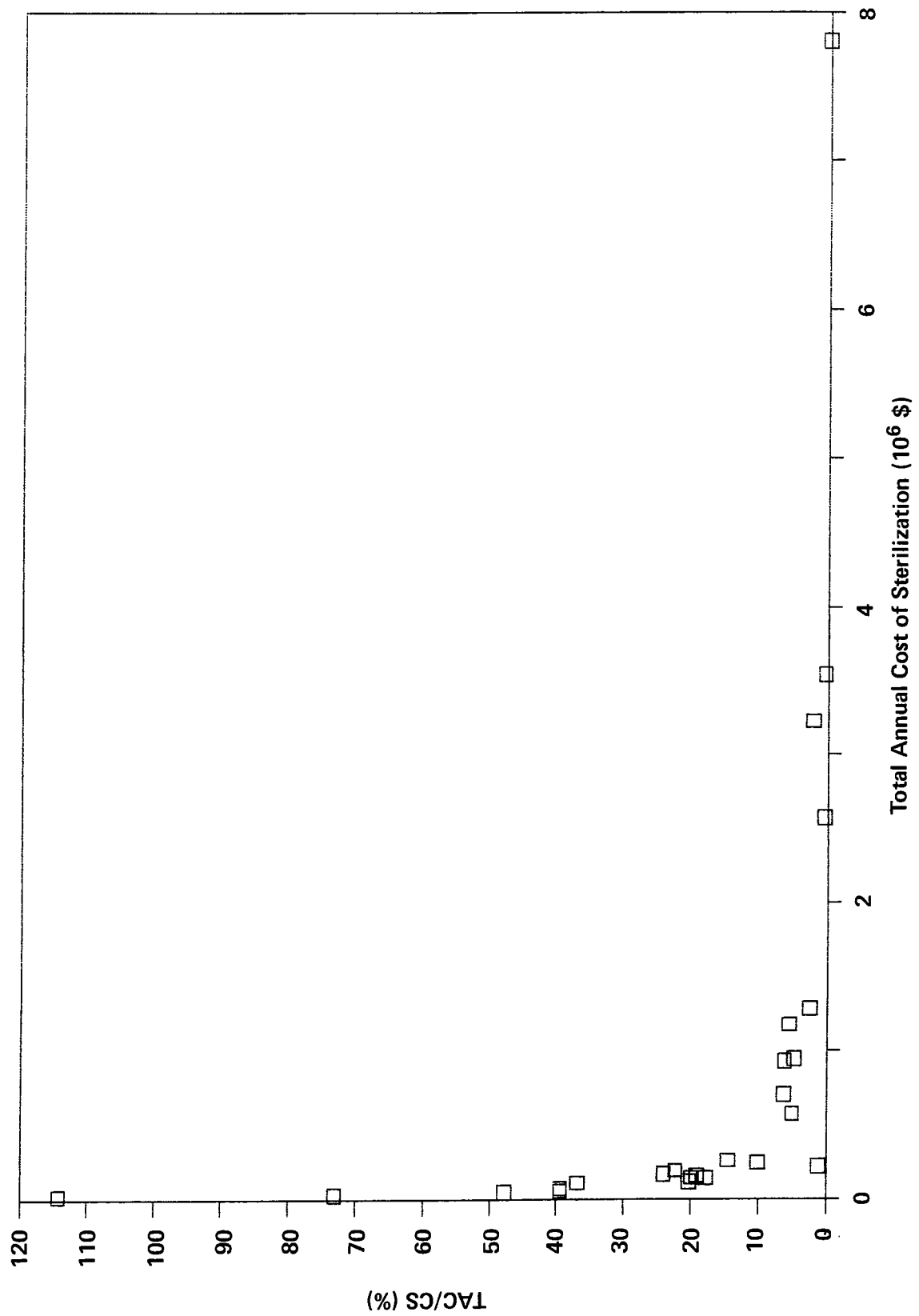
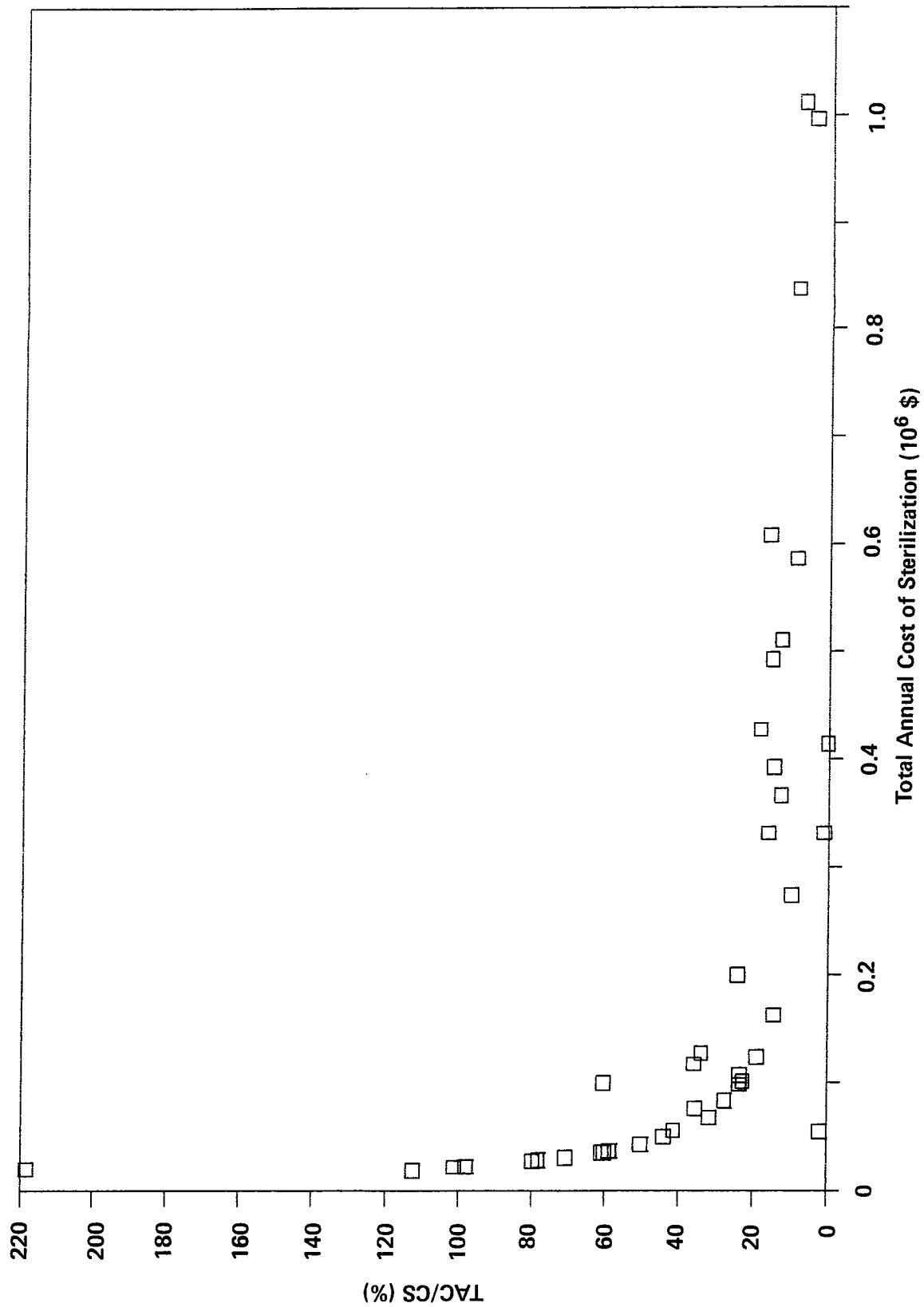


Figure 8-6. Scatter plot of TAC/CS and total annual cost of sterilization for other health-related suppliers.



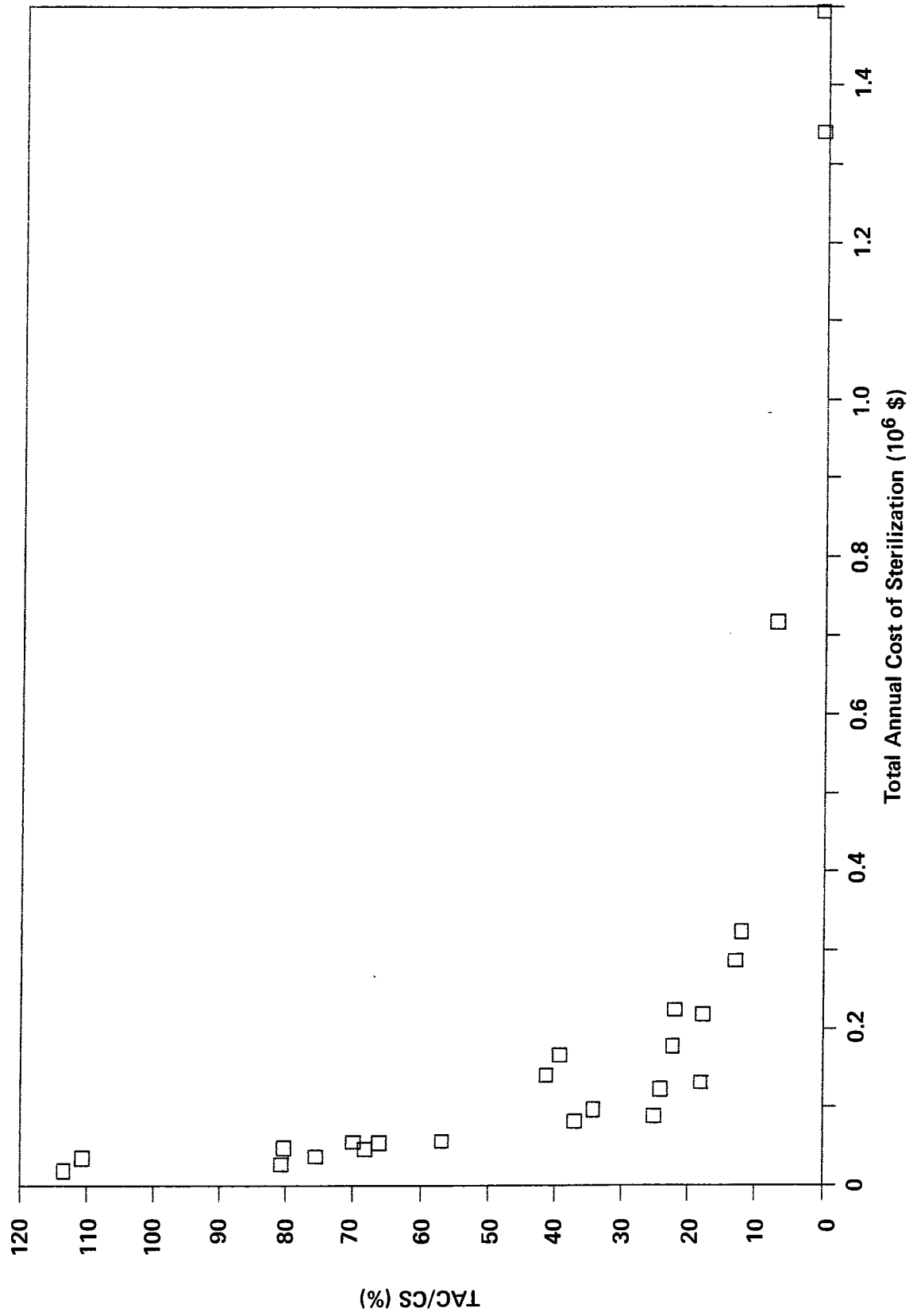


Figure 8-8. Scatter plot of TAC/CS and total annual cost of sterilization for spice manufacturers.

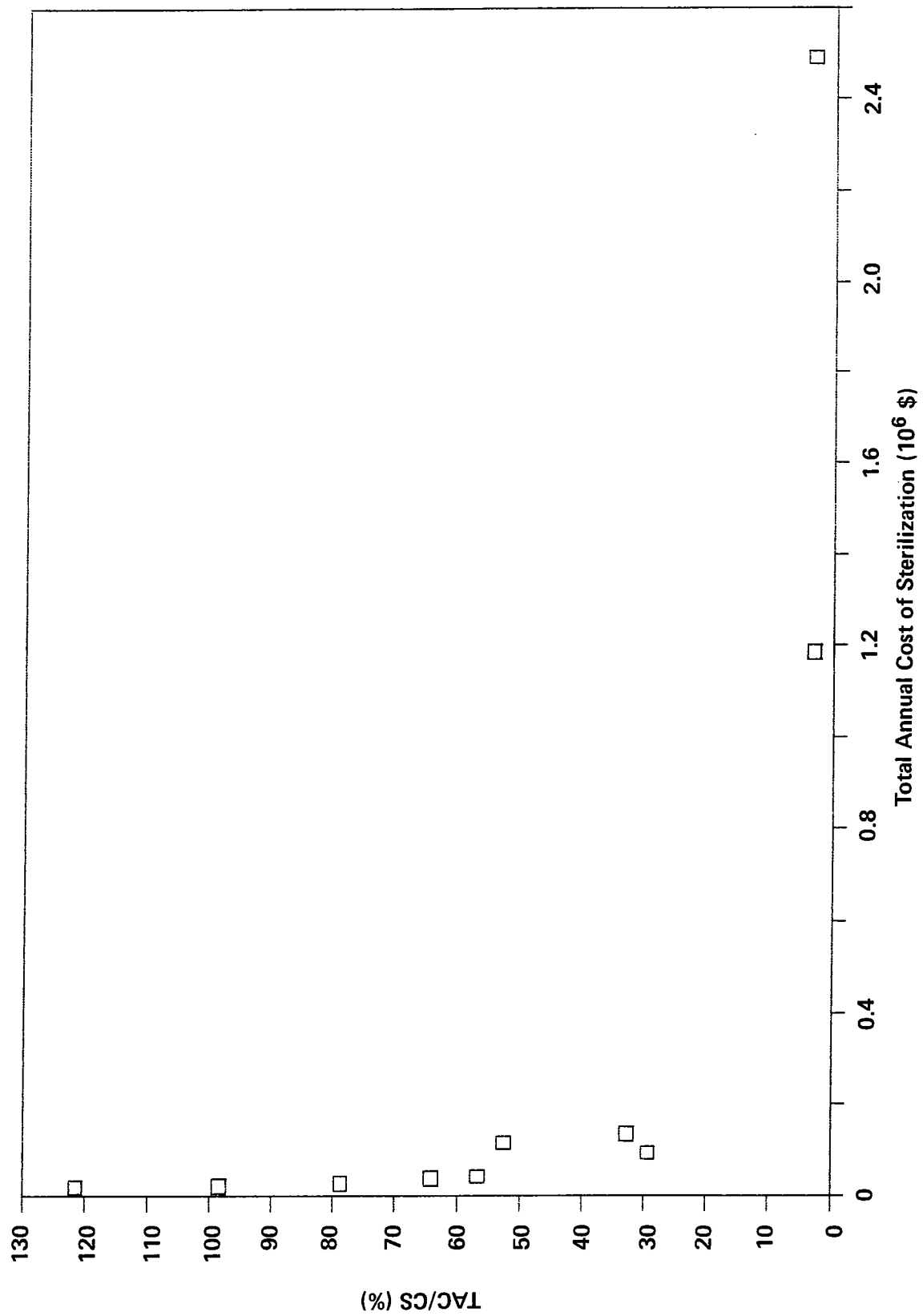


Figure 8-9. Scatter plot of TAC/CS and total annual cost of sterilization for laboratories.

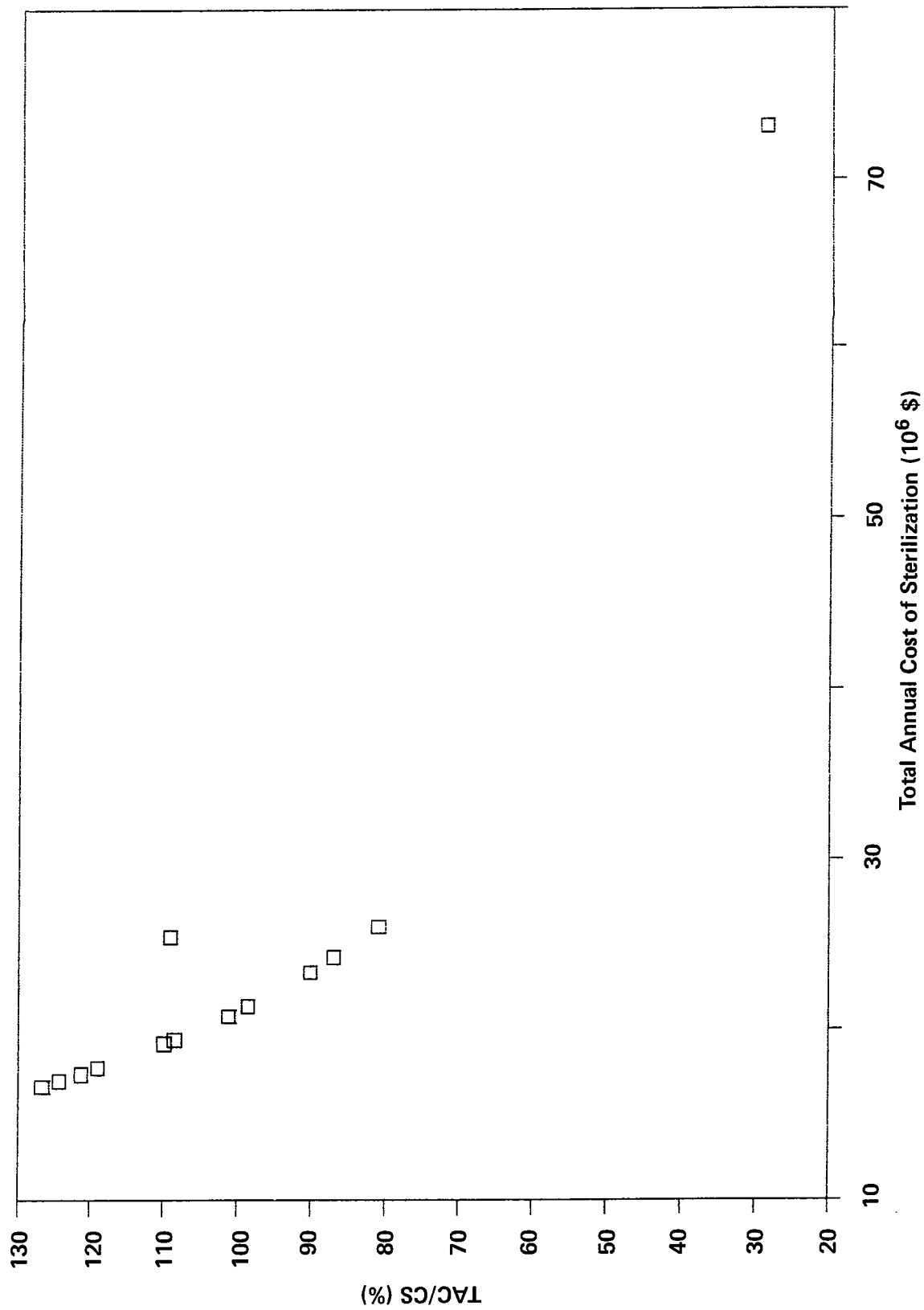


Figure 8-10. Scatter plot of TAC/CS and total annual cost of sterilization for museums and libraries.

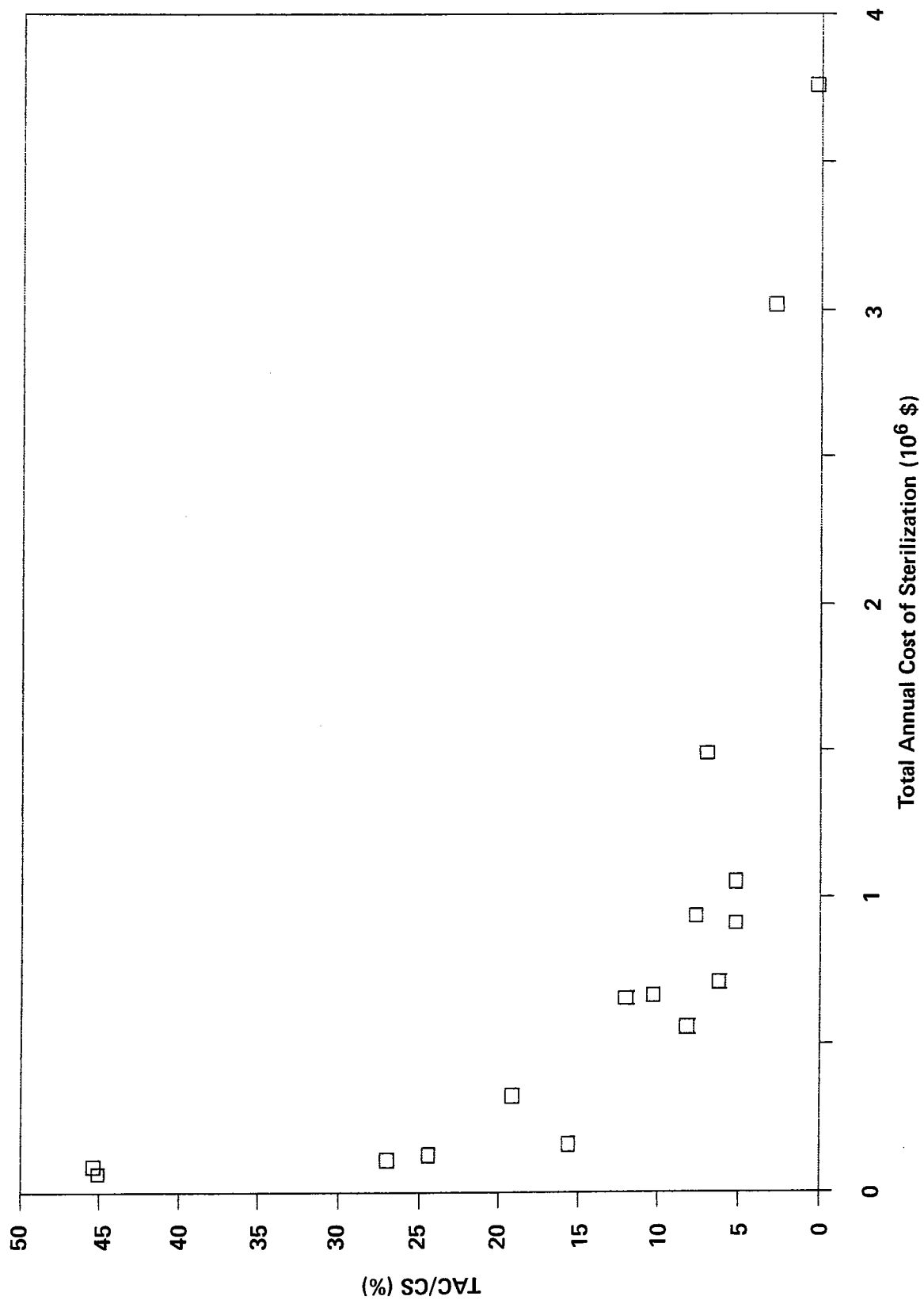


Figure 8-11. Scatter plot of TAC/CS and total annual cost of sterilization for contract sterilizers.

TABLE 8-17. SELECTED SUMMARY STATISTICS ON THE TOTAL ANNUALIZED
COST OF THE CANDIDATE NESHAP CONTROLS AS A PERCENTAGE
OF FACILITY SALES, 1986^{a,87}

Industry group	Median (%)	Range (%)
Medical equipment suppliers	0.11	<0.005 - 5.19
Other health-related suppliers	0.17	0.01 - 1.50
Pharmaceutical manufacturers	0.05	<0.005 - 10.1
Spice manufacturers	0.33	0.01 - 2.48
Museums and libraries ^b	4.22	0.23 - 12.9
Laboratories	0.27	0.01 - 4.94
Contract sterilizers	4.24	0.30 - 17.1

^aSome facility sales figures were unavailable and were estimated using parent company sales or a regression of facility sales on EO use.

^bRather than facility sales, operating budgets were estimated for each facility in this group.

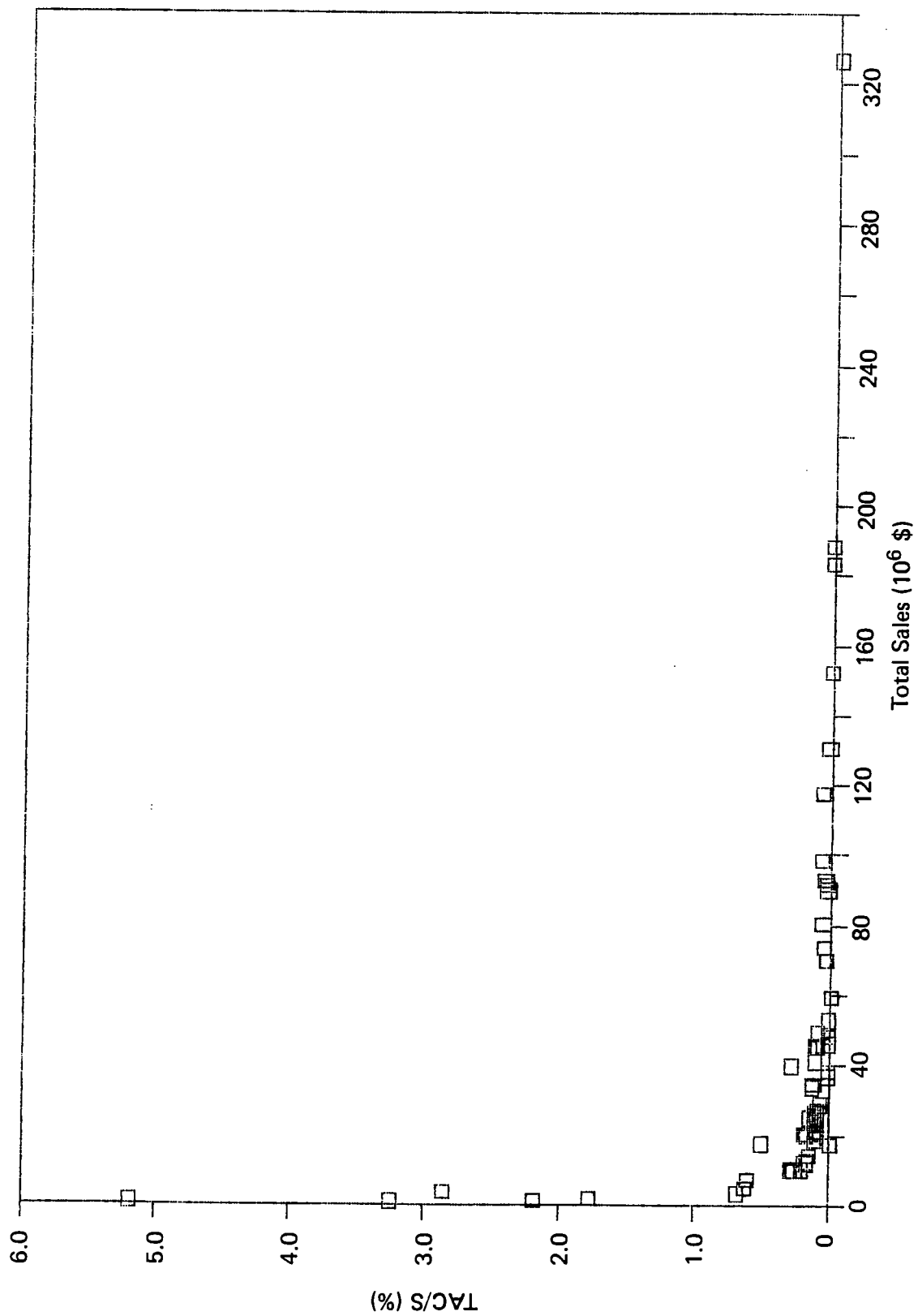


Figure 8-12. Scatter plot of TAC/S and total sales for medical equipment suppliers.

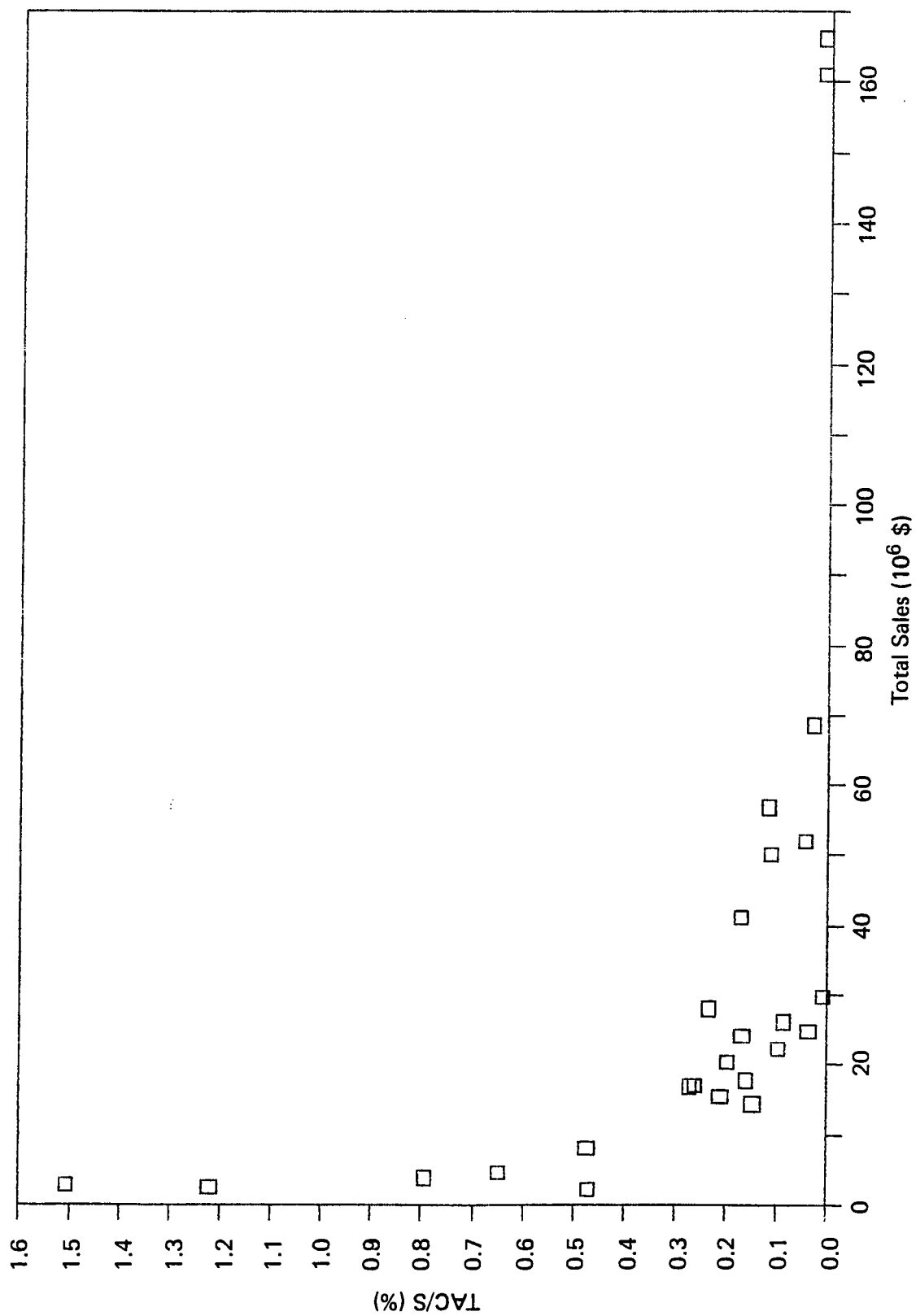


Figure 8-13. Scatter plot of TAC/S and total sales for other health-related suppliers.

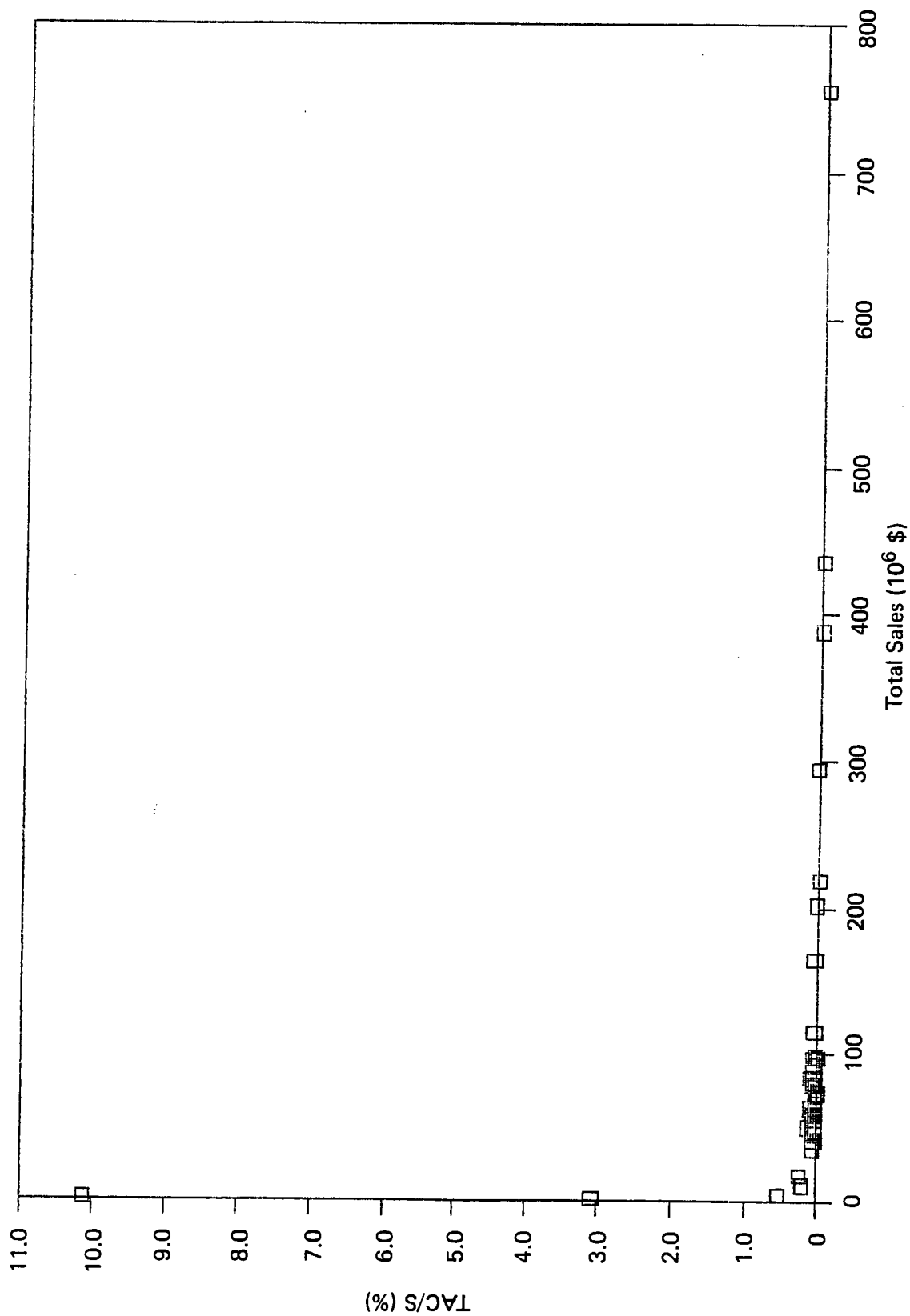
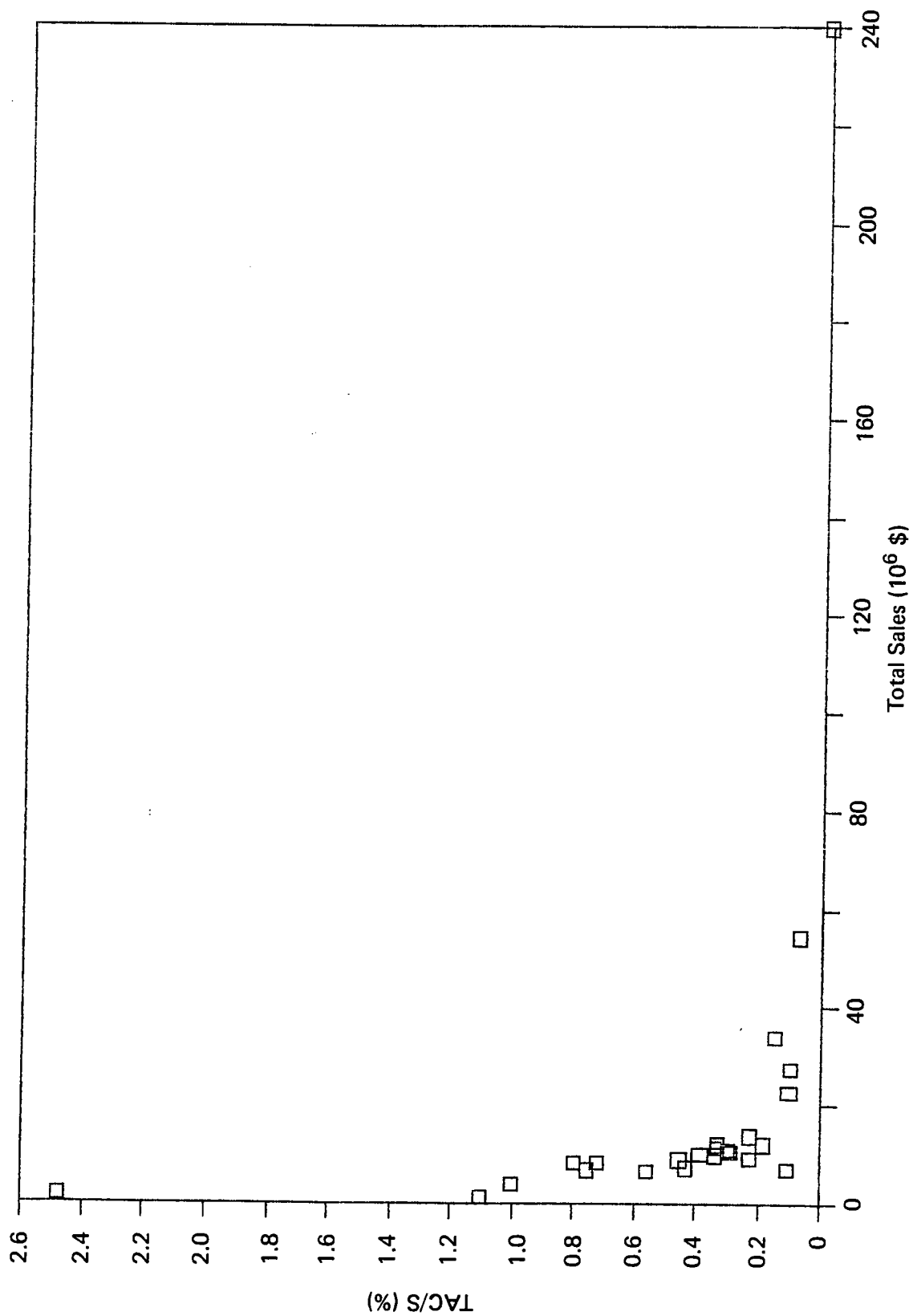


Figure 8-14. Scatter plot of TAC/S and total sales for pharmaceutical manufacturers.



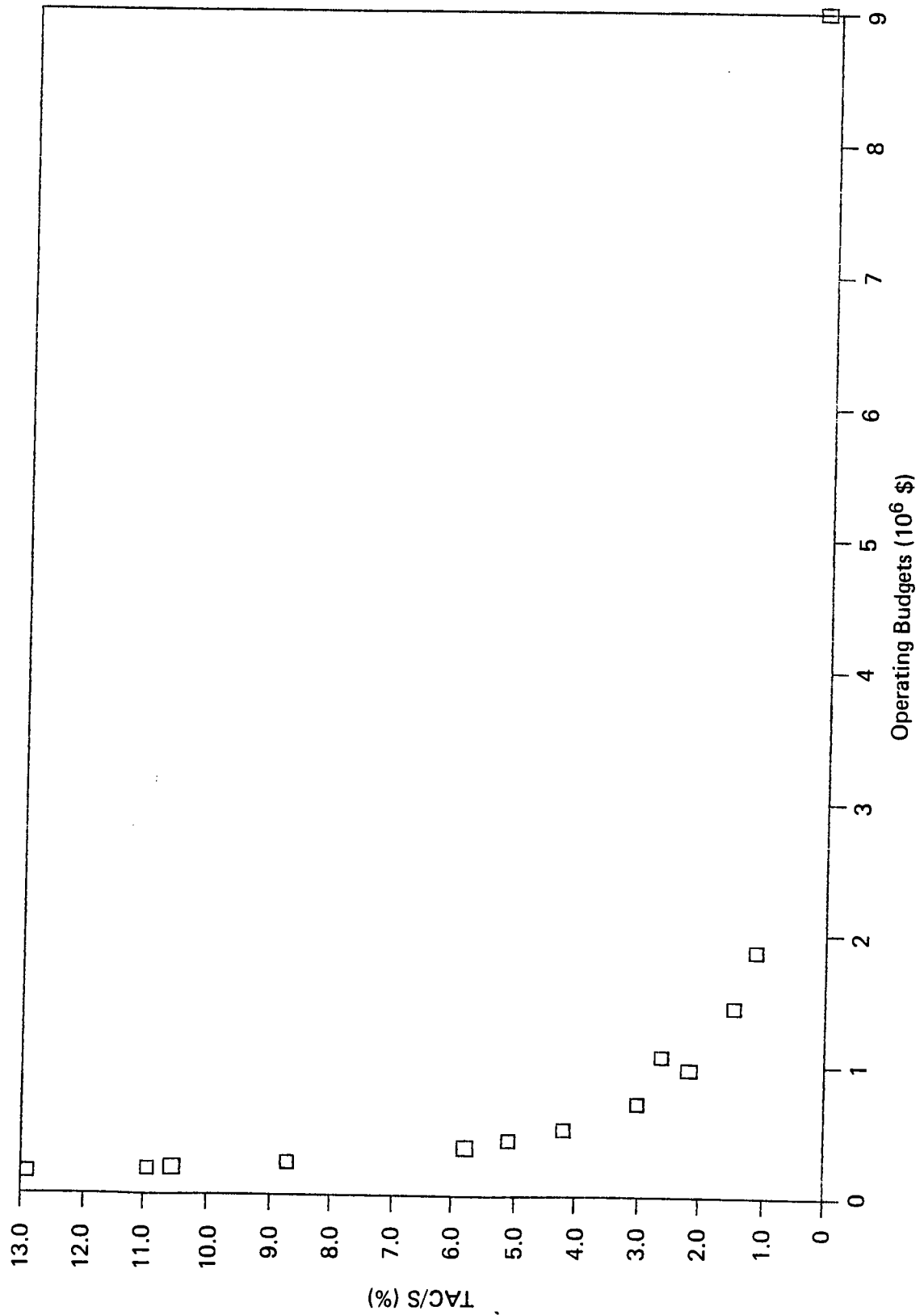


Figure 8-16. Scatter plot of TAC/S and operating budgets for museums and libraries.

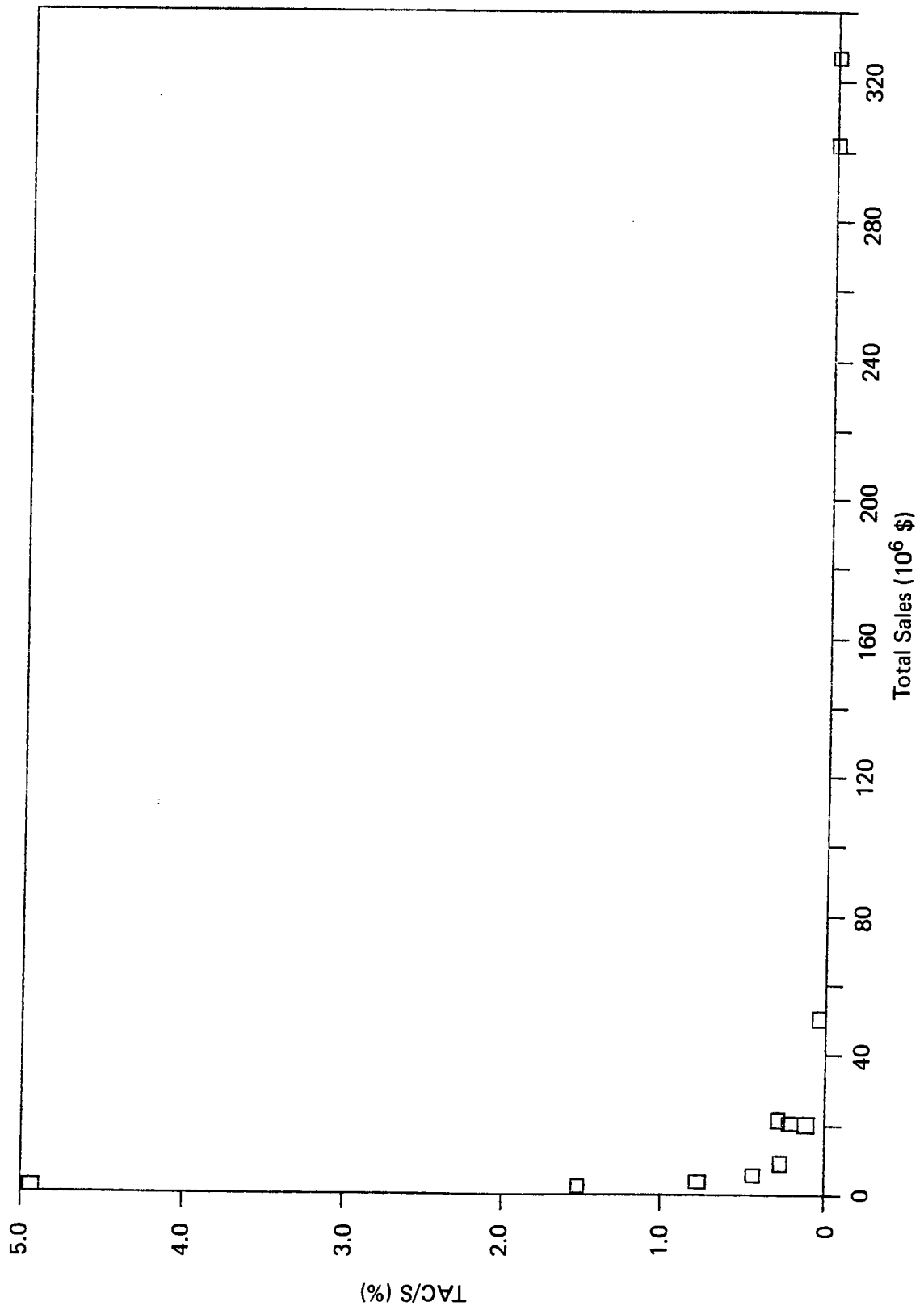


Figure 8-17. Scatter plot of TAC/S and total sales for laboratories.

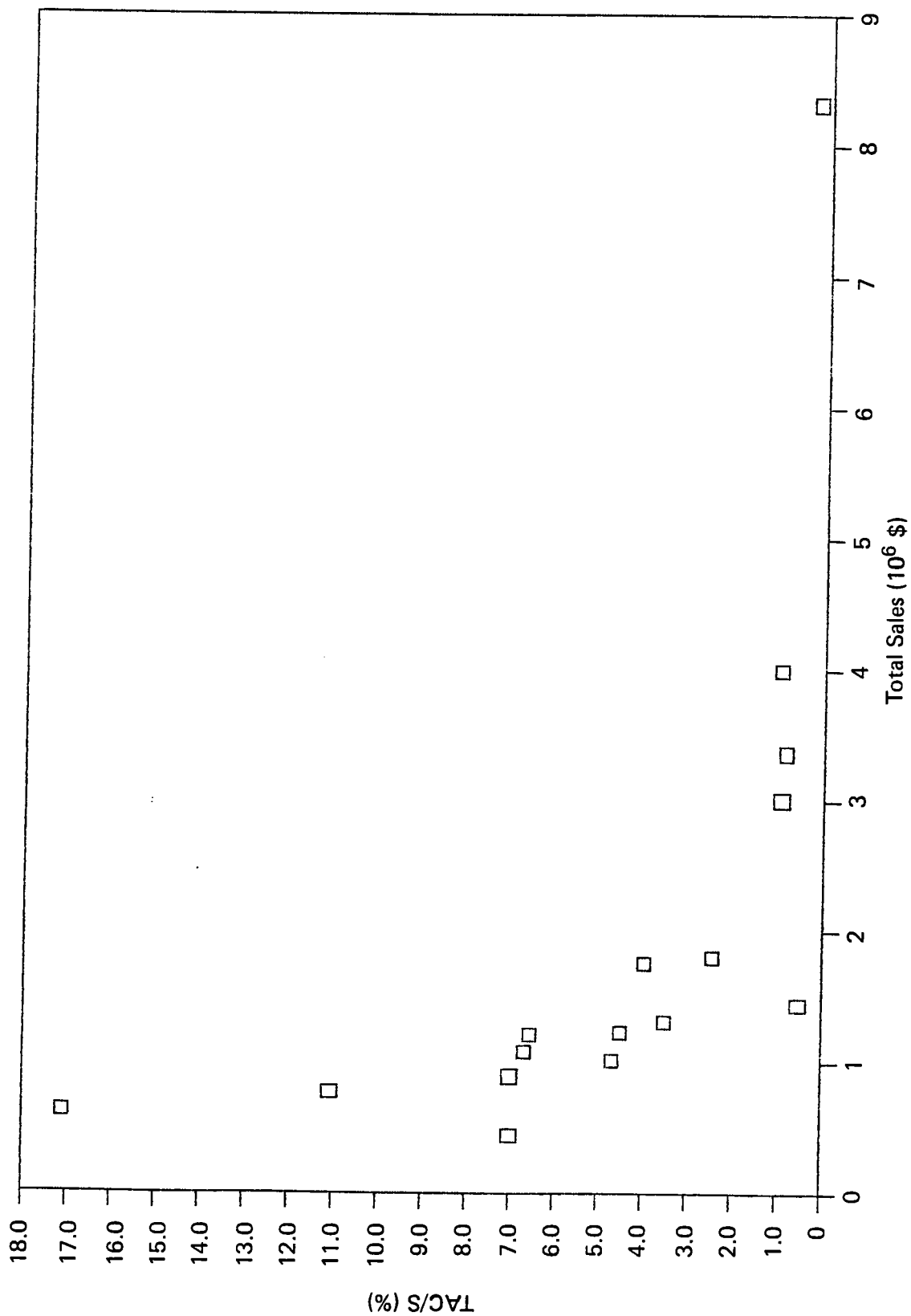


Figure 8-18. Scatter plot of TAC/S and total sales for contract sterilizers.

Furthermore, the TAC/S values indicate that the costs of the candidate NESHAP controls represent a significant percentage of the operating budget for many of the museums and libraries. To the extent that museums and libraries do not have ready access to capital markets, they may also have difficulty in getting the capital needed to acquire the relevant control devices.

Unlike the other industry groups, however, museums and libraries have a potentially cost-effective substitute for EO. As discussed in Section 8.1, VIKANE performs all of the museum/library fumigation functions for which EO has been used and is comparable in price. Although sterilization chambers may require some modification in order to use VIKANE, many museums and libraries may respond to the candidate NESHAP controls by substituting VIKANE for EO. Alternatively, some facilities in this group may discontinue fumigation altogether due to a lack of the capital necessary to switch to VIKANE or a perception that the value they receive from fumigation does not justify the additional cost of conversion to VIKANE.

The TAC/CV, TAC/EO, and TAC/CS values for the facilities in the laboratories group are relatively high, due to the below-average size of their sterilization chambers and relatively small quantity of EO they use. Nevertheless, the TAC/S values for the laboratories are low, which suggests that sterilization costs are a very small part of total production costs at these facilities. Although not knowing the precise figure, an animal-breeding laboratory indicated that sterilization costs are "surely less than 1 percent of total production cost."⁸⁸ Consequently, laboratories should absorb the costs of the candidate NESHAP controls without too much difficulty.

The median TAC/CS values for the medical equipment suppliers, other health-related suppliers, pharmaceutical manufacturers, and spice manufacturers range from 12.4 percent to 37.0 percent. Thus, the candidate NESHAP controls will substantially increase sterilization costs in the industry groups. However, sterilization costs are generally very small relative to the total cost of producing sterilized products in these industries. For example, a pharmaceutical manufacturer estimated that

sterilization costs represent only about 3 percent of total production costs.⁸⁹ Consequently, we do not expect the candidate NESHAP controls to significantly increase production costs for medical equipment suppliers, other health-related suppliers, pharmaceutical manufacturers, and spice manufacturers. The very low TAC/S values for these industry groups support this expectation.

For most industry groups in this study, sterilization is one of many steps in the production process. In contrast, sterilization is nearly the entire "product" for contract sterilizers.* Therefore, we expect the candidate NESHAP to cause a more pronounced increase in contract sterilizers' production costs. This is reflected in the relatively high median TAC/S (4.24%) for contract sterilizers.**

Despite the relatively large values for TAC/S among contract sterilizers, the candidate NESHAP will not necessarily have an adverse effect on contract sterilizers' business. Since contract sterilizers on average have larger chambers than the other industry groups and run more EO through them, the per-unit cost of the candidate NESHAP is less for contract sterilizers than for the other groups. This conclusion is supported by the data in Tables 8-14, 8-15, and 8-16, which indicate that contract sterilizers have the lowest median TAC/CV, TAC/EO, and TAC/CS of the seven industry groups. As explained in Appendix G, the contract sterilizers' lower per-unit control costs may actually cause them to gain additional business as firms switch from in-house sterilization to contract sterilization.

Aside from the effects of the candidate NESHAP controls on the museums and libraries group and the contract sterilizers group, significant effects

*As discussed in Section 8.1, many contract sterilizers perform some packaging, testing, and distribution services that are linked to their sterilization operations.

**As noted previously, one of the shortcomings of total sales is that it includes sales of sterilized and non-sterilized products. Since virtually all sales from contract sterilizers involve sterilized products, this shortcoming would tend to result in a higher TAC/S for these facilities than facilities in the other industry groups.

may occur at some individual facilities in the other five industry groups. In general, these are the facilities with the highest TAC/S values in Figures 8-12 through 8-18. Rather than incur the relatively high control costs, these facilities may switch to another sterilization process, switch from in-house to contract sterilization, or they may discontinue their production of sterilized products. Without further information on these facilities, we cannot predict which response might be chosen in each case.

8.2.4.2 Effects on New Facilities. Up to this point our analysis has been focused on the economic effects of the candidate NESHAP controls on existing facilities. Without data on possible control costs for new (not-yet-constructed) facilities in each industry group, we cannot make any quantitative estimates of the potential effects of the candidate NESHAP on these facilities. Nevertheless, we can reach some general conclusions on this matter based upon the information presented earlier in this chapter.

The apparent insignificance of control costs relative to total production costs for five of the seven industry groups suggest that the candidate NESHAP controls will have very little effect on investment decisions for new facilities in these five industry groups. Generally, emissions control costs for existing facilities are higher than the control costs for new facilities, because control equipment is usually more expensive to install once a facility is already built than it is as a part of the construction of new plants. Consequently, if the candidate NESHAP will have only minimal effects on existing facilities, it should not have much effect on new facilities.

As noted in the previous subsection, the candidate NESHAP controls may have a notable effect on the museums/libraries group and the contract sterilizers group. Thus, new facilities in these groups may be affected more than new facilities in the other five industry groups. In the case of museums and libraries, the candidate controls may cause new museums and libraries to use VIKANE as a sterilant, rather than EO. Since these two substances are comparable in price, it is unlikely that this substitution will have a significant adverse effect on decisions to invest in these new facilities.

As explained in Appendix G, the likely substitution of contract sterilization for in-house sterilization attributable to the candidate

NESHAP controls will increase the market share of the contract sterilizers group, and may even increase the quantity of goods sterilized by firms in this group. These substitution effects, in conjunction with the likelihood that new facilities will experience smaller costs from the candidate controls than existing facilities (as argued above), suggest that the NESHAP controls will not have important deleterious effects on new contract sterilization facilities.

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APPENDIX A.

EMISSION SOURCE TEST DATA

This appendix contains summaries of recent EPA and industry-conducted performance tests on scrubbers designed to remove ethylene oxide (EO) from sterilizer exhaust gas streams. Inlet and outlet tests were conducted on two types of acid/water scrubber systems, Damas™ and DEOXX™. Detailed descriptions of these types of scrubbers are presented in Chapter 3. The sterilizers studied use pure EO and a 12/88 mixture of EO and chloro-fluorocarbons (CFC) as sterilant gases. For all the tests, the removal efficiency of EO was greater than 99 percent by weight. Table A-1 presents a summary of the operating conditions and the results for each test.

A.1 EPA TEST OF A DEOXX™ SYSTEM AT BURRON MEDICAL

A.1.1 Facility Description¹

These field tests were conducted at Burron Medical, a medical supply sterilization facility, located in Allentown, Pennsylvania. The facility has three 28 m³ (1,000 ft³) sterilizers which use 12/88. The gas is supplied from a common header serving all four units and is controlled by a liquid flow meter.

A sterilization cycle typically uses 140 liters (x) (38 gallons [gal]) of 12/88 gas mixture. On a weight basis, a sterilization charge consumes 167 kg (368 lb) of gas, of which approximately 20 kg (44 lb) are EO. The initial charge of EO to the chamber was calculated using the weight of the supply cylinders before and after charging the chamber.

The exhaust from the sterilizers is controlled by a DEOXX™ system. At the time of the test, the scrubber contained a mixture of dilute phosphoric and sulfuric acid. The control system has a reported control efficiency of 99.99 percent based on tests conducted at the facility in April 1986 by the vendor.

TABLE A-1. SUMMARY OF TEST RESULTS

Plant	Scrubber type	Chamber size, m ³ (ft ³)	Sterilant	No. of runs	Flow rate m ³ /s (ft ³ /min)	Range of EO inlet concentrations, ppmv	Range of EO outlet concentrations, ppmv	Average percent removal
Burron Medical	DEOXX™	28.3 (1,000)	12/88	10 ^a	b	b	b	99.96 ^c
Johnson & Johnson	Damas™	b	12/88	6	0.031 (66)	b	14-1,938	99.25
		b	12/88	3	0.047 (100)	b	12-1,853	99.26
Chesebrough-Pond's, Inc.	DEOXX™	35.7 (1,260)	12/88	3	d	1,000-250,000	<1-10,000	99.03
		35.7 (1,260)	Pure EO	1	d			>99.99
McCormick & Company	DEOXX™	35.3 (1,248)	Pure EO	3	d	26,800-385,000	<5-458	99.988

^aSeventeen tests were performed; data from 10 of these tests were used in the report.

^bData not provided.

^cBased on throughput efficiency for empty chamber runs.

^dFlow rate varies widely for the various runs and evacuations.

Each chamber is equipped with a total recirculating vacuum pump. These pumps are equipped with gas/liquid separators which emit the gas to the DEOXX™ system and recirculate the liquid to the pump inlet. Chambers Nos. 1 and 2 are equipped with oil-sealed pumps. Chamber No. 3 is equipped with a water-sealed pump. All of the tests were conducted using the chambers (Nos. 1 and 2) equipped with oil-sealed pumps.

The sterilization cycle is controlled automatically by a programmable microprocessor system. The control system has the capability to control and record the parameters of the sterilization cycle including chamber temperature, chamber pressure, and elapsed time from the start of the cycle.

The sterilization process begins with a humidification step which takes place in a separate room. After the humidification step, each load to be sterilized is transferred to the sterilization chamber. The sterilization cycle is a batch process which takes 4 to 6 hours. A sterilizer load begun during the morning shift exhausts at about 2:00 p.m. In a typical plant operating mode, seven post-sterilization evacuations occur over a 3-hour period. After the chamber repressurizes, following the seventh evacuation, the product is removed from the chamber and allowed to off-gas. Although the control system is designed to handle the exhaust from two sterilizers venting simultaneously, the tested sterilization cycles were scheduled so that only one sterilizer vented at a time.

Three different sterilization programs were used for testing, one for the empty chamber tests, one for the full chamber tests, and one for the last full chamber test (Test 13). Before the start of every test (except Test 13), the chamber was evacuated to 2 pounds per square inch absolute (psia) and then pressurized to 3.1 psia with steam. The humidification step was maintained at 3.1 psia for 1 hour for the loaded chamber tests, but the humidification step was shortened to 5 minutes for the empty chamber tests. At the completion of the humidification, the chamber was charged to 23.9 psia with 12/88 gas. The exposure at 23.9 psia was maintained for 4 hours for the loaded chamber tests but was shortened to 5 minutes for the empty chamber tests. During the last full chamber test (Test 13), the chamber was evacuated to 7 psia and pressurized to 32.9 psia.

Each test program contained seven post-sterilization evacuations, the initial chamber evacuation and pump down and six air in-bleeds and subsequent evacuations, followed by a final air in-bleed. Except in Test 13, the chamber was evacuated to 2 psia and pressurized with air to 13.9 psia during each evacuation and air in-bleed cycle. The initial chamber evacuation and pump down lasted 26 to 27 minutes. The subsequent evacuations lasted 12 to 14 minutes, and the air in-bleeds required 12 to 14 minutes. During Test 13, the chamber was evacuated to 7.0 psia, which reduced each evacuation and air in-bleed time by 7 minutes.

Seventeen tests were performed, 5 with product in the chamber and 12 without product. Data from 10 of these tests were summarized in the final report. Table A-2 summarizes operating data from the 10 tests that were used.

A.1.2 Sampling Procedures¹

The sampling and analysis procedure used in these field tests involves semicontinuous direct sampling with on-line gas chromatographic analysis. Samples were acquired at two locations, before and after the control unit. At the scrubber inlet, the EO and CFC-12 concentrations were at percent levels, and the sample temperatures were 40° to 50°C (100° to 120°F). At the scrubber outlet, the EO concentrations were at the low ppmv level, CFC-12 concentrations were at the percent levels, and sample temperatures ranged from 0° to 20°C (30° to 70°F) depending on the ambient temperature at the time of the test.

A.1.3 Test Results¹

Table A-3 presents uncontrolled and controlled emissions (i.e., the amount of EO entering and exiting the control unit) for the six empty chamber tests. These emissions measurements are used to evaluate the EO control efficiency of the DEOXX™ system. Throughput efficiency was calculated using the emissions into and out of the DEOXX™ unit. Recovery efficiency was calculated using the weight of the original EO charge and the measured EO emissions at the outlet of the control unit.

Statistical tests were performed to determine the effect of a product in the chamber on the efficiency of the control unit. These tests showed that the presence of product in the chamber had no significant effect on the efficiency determinations.

TABLE A-2. SUMMARY OF FIELD TESTS AT BURRON MEDICAL¹

Test No.	Product present	Chamber No.	Weight of 12/88 used, lb	Test date	Test start time	Test end time
6 ^a	Yes	2	368	87/10/06	21:39	00:38
7 ^b	No	1	365	87/10/07	10:19	14:04
8 ^a	Yes	2	388	87/10/07	15:10	18:11
9 ^b	No	1	346	87/10/08	09:25	12:42
10 ^b	No	1	353	87/10/08	14:41	17:48
11 ^a	Yes	2	392	87/10/08	18:00	21:01
12 ^b	No	1	346	87/10/09	12:44	15:53
13 ^c	Yes	2	442	87/10/09	16:16	18:03
14 ^b	No	1	350	87/10/10	08:54	12:01
15 ^b	No	1	343	87/10/10	13:35	16:43

^aThe chamber was evacuated to 2 psia before being pressurized with steam to 3.1 psia. Humidification step lasted 1 hour and then the chamber was charged to 23.9 psia with 12/88. Exposure lasted 4 hours. Post-sterilization chamber pressure cycled between 2 psia and 13.9 psia.

^bThe chamber was evacuated to 2 psia before being pressurized with steam to 3.1 psia. Humidification step lasted 5 minutes and then the chamber was charged to 23.9 psia with 12/88. Exposure lasted 5 minutes. Post-sterilization chamber pressure cycled between 2 psia and 13.9 psia.

^cThe chamber was evacuated to 7 psia before being pressurized with steam to 8 psia. Humidification step lasted 1 hour and then the chamber was charged to 32.9 psia with 12/88. Exposure lasted 5 hours. Post-sterilization chamber pressure cycled between 7 psia and 13.5 psia.

TABLE A-3. SUMMARY OF EMISSION MEASUREMENTS AND CONTROL EFFICIENCIES FOR
EMPTY CHAMBER TESTS AT BURRON MEDICAL¹

Test No.	Initial EO charged to chamber, kg (lb)	EO left in chamber, kg (lb)	EO entering control unit, kg (lb)	EO exiting control unit, kg (lb)	Throughput effi- ciency, percent ^a	Recovery effi- ciency, percent ^b
7 ^c	19.9 (43.8)	0.19 (0.42)	10.98 (24.19)	0.020 (0.043)	99.82	99.90
9	18.8 (41.5)	0.68 (1.50)	27.51 (60.59) ^d	0.005 (0.011)	99.98	99.97
10	19.2 (42.4)	0.10 (0.22)	28.20 (62.12) ^d	0.013 (0.029)	99.95	99.93
12	18.8 (41.5)	0.07 (0.16)	19.98 (44.00)	0.005 (0.011)	99.98	99.97
14	19.1 (42.0)	0.07 (0.16)	22.16 (48.80)	0.010 (0.021)	99.96	99.95
15	18.7 (41.2)	0.03 (0.07)	23.98 (52.82)	0.006 (0.014)	99.97	99.97

^aCalculated using the emissions entering and exiting the control device.

^bCalculated using the weight of the original EO charge and the measured EO emissions at the outlet of the control device.

^cDuring Test 7 there was a leak in the inlet sampling pump during the first 10 minutes of the evacuation and the FID flame was extinguished during portions of the third and fourth evacuations. Loss of these samples may explain the lower mass of EO entering the control unit during this test.

^dThe EO standard calibration curve for inlet samples on October 8, 1987, was lower than on the other test days. This would have raised the measured EO concentrations, and caused the EO mass flow into the control unit to be over estimated.

The absolute difference between measured emissions and expected emissions (based on the initial EO charge to the chamber) was greater than 40 percent for three tests and less than 10 percent for only one test. In five of the six empty chamber tests, the measured emission levels were higher than the expected levels. Thus, the measured uncontrolled EO emissions may range anywhere from 50 to 150 percent of the actual emissions.

A.2 TEST OF A DEOXX™ SYSTEM AT McCORMICK AND COMPANY, INC.

A.2.1 Facility Description²

A DEOXX™ detoxification system was installed at the Hunt Valley Spice Mill of McCormick and Company to control EO emissions from sterilizers. The DEOXX™ system was tested the week of October 14, 1985, to evaluate performance.

The sterilizers at the Hunt Valley Spice Mill are used to process a variety of spices. Pure EO is used as the sterilant. Each sterilizer is equipped with a total-recirculation liquid ring vacuum pump system to evacuate the chamber and achieve the desired levels of vacuum. At the completion of the sterilization cycle, sterilizer gas is exhausted to the atmosphere through the DEOXX™ system.

The test program was conducted using Sterilizer B and included a total of four tests. The first test was used to check the equipment and instrumentation operation. The remaining three tests (Test Nos. 2, 3, and 4) were used to evaluate the DEOXX™ system performance. Figure A-1 provides locations of the sampling points.

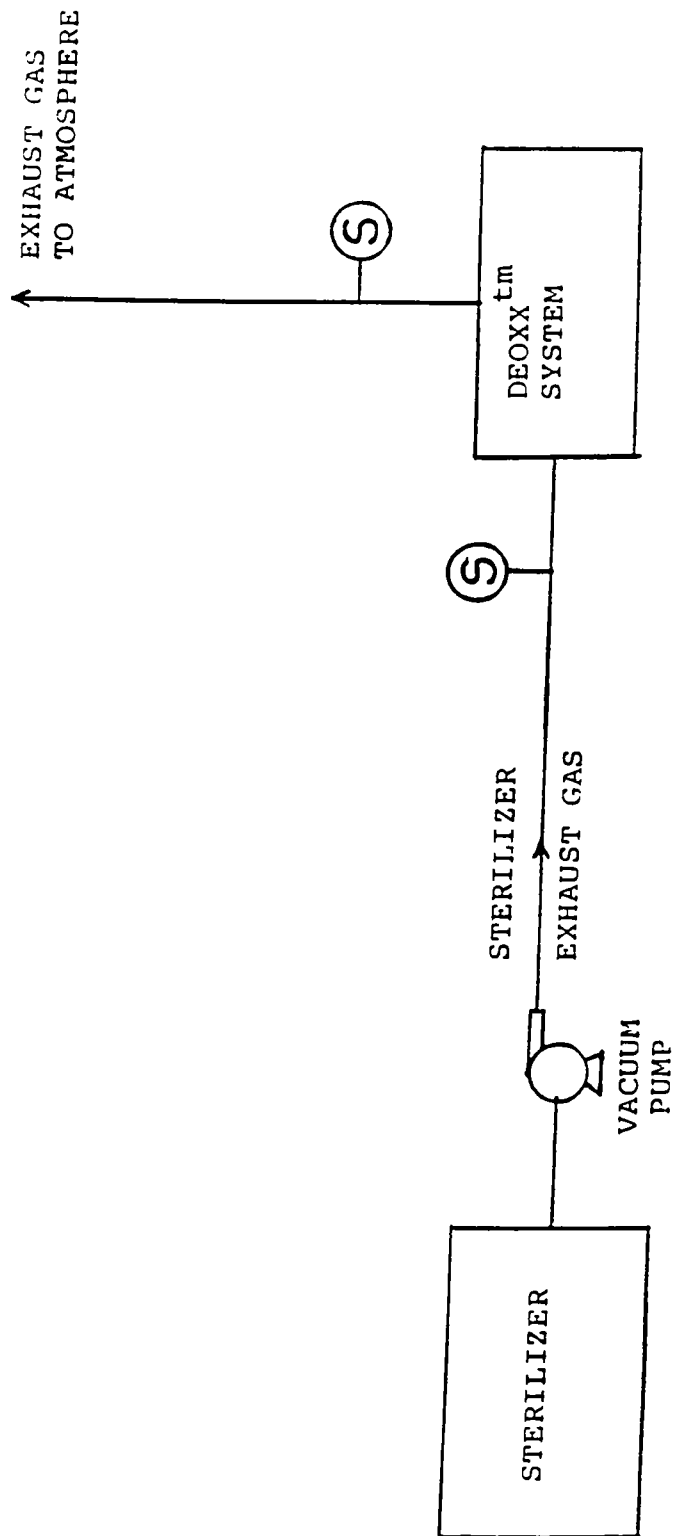
The sterilization cycle operating conditions for the three performance tests are summarized below:

Initial evacuation conditions:

Pressure, psia (in. Hg)	14.2 (28.9)
Time, min	25

Total EO charged to chamber, kg (lb):

Test No. 1	13.2 (29.0)
Test No. 2	13.2 (29.0)
Test No. 3	12.7 (28.0)



- Ⓢ : SAMPLING POINT TO MEASURE
- ETO CONCENTRATION
 - VOLUMETRIC GAS FLOWRATE
 - GAS TEMPERATURE
 - GAS STATIC PRESSURE

Figure A-1. Sampling point locations.²

Exposure conditions:

Pressure, psia (in. Hg)	10.4 (21.2)
Temperature, °C (°F)	43.3 (110)

Following the sterilization cycle, the chamber was evacuated to 7.0 psia (14.3 in. Hg) over a period of 12 minutes. Two additional evacuations lasted 10 minutes each, and the air washes required less than 1 minute each.

A.2.2 Sampling Procedures²

The total amount (weight) of EO entering and leaving the DEOXX™ system was monitored to determine the EO removal efficiency of the system. The sterilization chamber was kept empty during the test cycles. This eliminated possible EO emission variations during the exhaust phase due to product off-gassing, without adversely affecting the performance evaluation of the DEOXX™ system.

For each performance test cycle, the amount of EO charged to the sterilizer was determined by measuring the weight of the EO supply-cylinder before and after charging EO to the sterilizer chamber.

The weights of EO entering and leaving the DEOXX™ system were determined for each chamber evacuation by continuously monitoring the total volumetric gas flow rate and EO concentration at the inlet and the outlet of the DEOXX™ system. The volumetric gas flow rate was measured by using an orifice meter at each location. The gas pressure drop across the orifice plate was monitored throughout the exhaust cycle for accurate measurement of gas flow rate. The EO concentrations were measured with two gas chromatographs, one each at the inlet and the outlet of the DEOXX™ system.

A.2.3 Test Results

The weights of EO entering and leaving the DEOXX™ system for each evacuation, as well as the removal efficiencies associated with each test run are presented in Table A-4. A summary of the continuous monitoring data for test run No. 2 is presented in Section A.5 of this Appendix.

A.3 JOHNSON AND JOHNSON DAMAS™ TEST

A Damas™ scrubber is used to control EO emissions from the sterilization operations at Johnson & Johnson's Ethicon, Inc., facility in

TABLE A-4. SUMMARY OF EMISSION MEASUREMENTS AND CONTROL EFFICIENCIES FOR TESTS AT MCCORMICK AND COMPANY, INC., SPICE MILL²

Test No.	Initial EO charged to chamber, kg (lb)	EO left in chamber, kg (lb)	EO entering control unit, kg (lb)	EO exiting control unit, kg (lb)	Throughput effi- ciency, percent ^a	Recovery effi- ciency, percent ^b
2	13.2 (29.0)	0.32 (0.71)	12.19 (26.85)	0.00130 (0.00287)	99.989	99.990
3	13.2 (29.0)	0.30 (0.67)	12.02 (26.47)	0.00140 (0.00309)	99.988	99.989
4	12.7 (28.0)	0.32 (0.70)	11.99 (26.41)	0.00169 (0.00372)	99.986	99.987

^aCalculated using the emissions entering and exiting the control device.

^bCalculated using the weight of the original EO charge and the measured EO emissions at the outlet of the control device.

Somerville, New Jersey. The sterilizer uses a 12/88 mixture of EO/CFC as the sterilant. All concentrations reported are based on gas chromatographic (GC) analyses. The EO concentration at the scrubber inlet was based on an average of three samples. Nine analyses were performed on the scrubber outlet: six with a scrubber flow rate of 0.031 cubic meters/second (m^3/s) (66 cubic feet per minute [ft^3/min]) (Set 1) and three with a flow rate of 0.047 m^3/s (100 ft^3/min) (Set 2). The peak outlet concentration for each analysis was used to calculate the removal efficiency of the scrubber. The average scrubber efficiency was 99.25 percent for Set 1 and 99.28 percent for Set 2. The average removal efficiency for all nine runs was 99.26 percent.³

A.4 CHESEBROUGH-POND'S DEOXX™ TEST

A DEOXX™ system was installed on sterilizer No. 4 at Chesebrough-Pond's Sherburne, New York, plant in 1982 to control EO emissions. Measurements of the gas flow rate and EO concentration at the inlet and outlet of the DEOXX™ system were conducted to evaluate the performance of the system. The EO concentrations at the inlet and the outlet were determined by gas chromatography.⁴

The 35.7 m^3 (1,260 ft^3) sterilizer is capable of using either pure EO or a mixture of 12/88 EO/CFC as the sterilant gas. A total of four performance tests were conducted on the DEOXX™ system: three using the 12/88 mixture and one using pure EO gas. The removal efficiencies for the three 12/88 mixtures were 99.0 percent, 98.7 percent, and 99.4 percent, respectively, for an average of 99.0 percent. For the pure EO mixture, the EO removal efficiency was greater than 99.99 percent.⁴

A.5 CONTINUOUS MONITORING DATA FOR TEST RUN NO. 2 AT McCORMICK SPICE
MILL²

INLET FLOWRATE

TEST #	2	EVACUATION #	1	DATE	10/17/85				
TIME	ELAPSED TIME	ORIFICE SIZE ^A	ΔP ("H ₂ O)	P ("H ₂ O)	T (°F)	C (MMW)	MW	ACFM	SCFM
10:15:00	0	5	0.3	0.5	70	28,000	29.42	8.969	8.811
10:15:30	0:30		0.3	0.5	72	27,500	29.41	8.954	8.763
10:16:00	1:00		1.1	2.5	72	27,000	29.41	17.188	16.904
10:16:30	1:30		1.6	3.0	72	27,000	29.41	20.742	20.424
10:17:00	2:00		1.8	3.0	74	26,000	29.39	21.966	21.548
10:17:30	2:30		2.0	2.5	76	31,000	29.47	23.066	22.515
10:18:00	3:00		2.0	2.5	77	73,000	30.10	22.802	22.216
10:18:30	3:30		1.8	2.0	77	137,500	31.06	21.282	20.710
10:19:00	4:00		1.7	2.0	78	253,000	32.80	20.103	19.531
10:19:30	4:30		1.5	1.5	79	298,000	33.47	18.669	18.077
10:20:00	5:00		1.3	1.1	79	331,000	33.97	17.243	16.680
10:20:30	5:30		1.2	1.0	80	354,000	34.31	16.467	15.896
10:21:00	6:00		3.5	4.0	80	373,000	34.60	28.108	27.333
10:21:30	6:30		3.5	3.8	80	385,000	34.78	28.028	27.242
10:22:00	7:00		3.2	3.8	81	384,000	34.76	26.783	25.984
10:22:30	7:30		3.1	3.8		381,000	34.72	26.376	25.589
10:23:00	8:00		3.0	3.5		377,000	34.66	25.960	25.167
10:23:30	8:30		2.8	3.2		372,000	34.58	25.100	24.315
10:24:00	9:00		2.8	3.1		366,000	34.49	25.129	24.338
10:24:30	9:30		2.6	3.0		359,000	34.39	24.247	23.478
10:25:00	10:00		2.5	3.0		352,000	34.29	23.815	23.059
10:25:30	10:30		2.5	3.0		343,000	34.15	23.860	23.103
10:26:00	11:00		2.4	3.0		336,500	34.05	23.412	22.669
10:26:30	11:30		2.3	2.9		329,000	33.94	22.954	22.220
10:27:00	12:00		2.2	2.7		324,000	33.86	22.470	21.741
10:27:30	12:30		0	0				0	0

INLET FLOWRATE

TEST #	2	EVIACUATION #	3	DATE	10/17/95				
TIME	ELAPSED TIME	ORIFICE SIZE	ΔP ("H ₂ O)	P ("H ₂ O)	T (°F)	C (ppmw)	MW	ACFM	SCFM
10:42:25	0	B	5.5	10.5	80	182,000	31.73	105.948	104.657
10:42:55	0:30		4.6	9.0	80	152,000	31.23	97.411	95.878
10:43:25	1:00		4.2	7.5	81	125,000	30.38	93.425	91.454
10:43:55	1:30		3.5	6.5		107,000	30.61	85.557	83.550
10:44:25	2:00		3.0	5.5		97,000	30.46	79.509	77.261
10:44:55	2:30		2.5	4.7		94,000	30.41	72.388	70.382
10:45:25	3:00		2.2	4.0		93,000	30.40	67.860	65.867
10:45:55	3:30		1.8	3.3	80	92,000	30.38	61.406	59.611
10:46:25	4:00		1.6	3.0	80	92,000	30.38	57.873	56.140
10:46:55	4:30		2.5	9.5	78	92,000	30.38	47.312	48.777
10:47:25	5:00		7.7	8.0		91,220	30.37	44.793	44.150
10:47:55	5:30		6.2	12.3		89,000	30.34	41.073	40.899
10:48:25	6:00		5.5	11.0		87,000	30.31	38.035	37.756
10:48:55	6:30		4.7	9.0		86,000	30.29	35.055	34.567
10:49:25	7:00		6.2	12.5		84,000	30.26	40.452	40.225
10:49:55	7:30		5.5	11.5		83,000	30.25	38.061	37.757
10:50:25	8:00		5.0	10.3		82,000	30.23	36.249	35.856
10:50:55	8:30		4.6	7.5		80,500	30.21	34.747	34.305
10:51:25	9:00		4.2	8.5		80,000	30.20	33.168	32.667
10:51:55	9:30		3.8	8.0		79,000	30.19	31.535	31.022

INLET ITO CONCENTRATION

TEST # 2 EVACUATION # 1 DATE 10/17/85

TIME	ELAPSED TIME (min)	CONCENTRATION (PPMV)
10:15	0	28,900
10:17	2	26,800
10:19	4	258,000
10:22	7	384,000
10:24	9	367,000
10:27	12	324,000
10:29	14	307,000

INLET ETO CONCENTRATION

TEST # 2 EVACUATION # 2 DATE 10/17/85

TIME	ELAPSED TIME	CONCENTRATION (PPMV)
10:30:10	0	—
10:32	1:50	205,000
10:35	4:50	197,000
10:38	7:50	166,000
10:41	10:50	156,000

INLET IETO CONCENTRATION

TEST # 2 EVACUATION # 3 DATE 10/17/85

TIME	ELAPSED TIME (min)	CONCENTRATION (PPMV)
10:42:25	0	—
10:43	0:35	152,000
10:45	2:35	92,100
10:47	4:35	94,400
10:50	7:35	85,400
10:52	9:35	77,300
10:54	11:35	79,100
10:57	14:35	73,400

OUTLET FLOWRATE

TEST #	2	EVACUATION #	1	DATE	10/17/85		
TIME	ELAPSED TIME	ORIFICE SIZE*	ΔP ("H ₂ O)	P ("H ₂ O)	T (°F)	ACFM	SCFM**
10:17:00	0	5	0.5	0.5	67	8.977	8.869
10:17:30	0:30		0.4	1.5	68	8.032	7.939
10:18:00	1		0.4	2.3	68	8.040	7.963
10:18:30	1:30		2.2	—	68	18.852	18.667
10:19:00	2		2.2	—	68	18.852	18.667
10:19:30	2:30		2.0	1.5	67	17.976	17.803
10:20:00	3		0.9	0.9	67	12.169	12.034
10:21:00	4		0.6	0.6	67	9.835	9.719
10:22:00	5		0.5	0.5	67	8.977	8.869
10:23:00	6		1.6	1.6	66	16.096	15.975
10:24:00	7		1.9	1.9	↓	17.546	17.427
10:25:00	8		1.4	1.3		15.051	14.927
10:26:00	9		1.3	1.3		14.503	14.383
10:27:00	10		1.2	1.2		13.933	13.815
10:28:00	11	1.2	1.2	13.933		13.815	
10:29:00	12	0	0	0.00	0.00		
10:30:00	13						

* S or B
 ** ⑬ 60°F and 1 atm

13-39

Q = $C \sqrt{\frac{\Delta P}{\rho}}$ where ΔP is in "H₂O
 Q is in ACFM P is in psia T is in °F
 C = 75.9687
 C = 218.4097

OUTLET FLOWRATE

TEST #	2	EVACUATION #	2	DATE	10/17/85		
TIME	ELAPSED TIME	ORIFICE SIZE*	ΔP ("H ₂ O)	P ("H ₂ O)	T (°F)	ACFM	SCFM**
10:31:00	0	B → S →	5.0	4.0	66	82.044	81.905
10:31:55	0:55		3.9	4.3	↓	72.486	72.416
10:32:30	1:30		3.0	3.8	66	63.536	63.398
10:33:00	2		2.6	3.4	67	59.120	58.934
10:33:30	2:30		2.0	3.0	→	51.777	51.466
10:34:00	3		1.5	1.6		44.763	44.342
10:34:30	3:30		1.5	1.5		44.758	44.326
10:35:00	4		1.2	1.2		40.018	39.603
10:35:30	4:30		1.0	1.0		36.522	36.125
10:36:00	5		6.5	6.4		32.601	32.674
10:37:00	6		4.5	4.5	27.063	26.998	
10:38:00	7		6.5	5.9	32.581	32.614	
10:39:00	8	4.8	4.8	27.961	27.915		
10:40:00	9	4.0	4.0	25.476	25.337		
10:41:00	10	3.5	3.4	23.813	23.648		
10:42:00	11	0	0	0.00	0.00		
10:43:00	12						

44.1'

* S or B
 ** @ 60°F and 1 atm

$Q = C \sqrt{\frac{\Delta P}{\rho \cdot T}}$ where ΔP is in "H₂O
 Q is in ACFM P is in psia T is in °F

$C = 75.9687$
 $C = 218.4097$

OUTLET FLOWRATE

TEST #	2	EVACUATION #	3	DATE	10/17/85		
TIME	ELAPSED TIME	ORIFICE SIZE*	ΔP ("H ₂ O)	P ("H ₂ O)	T (°F)	ACFM	SCFM**
10:44:15	0	B	6.5	5.5	68	93.538	93.366
10:44:30	0:15		5.1	4.4		82.744	82.371
10:45:00	0:45		4.6	4.0		78.545	78.115
10:45:30	1:15		3.7	3.4		70.392	69.905
10:46:00	1:45		3.1	2.8		64.385	63.846
10:46:30	2:15		2.7	3.3		60.124	59.693
10:47:00	2:45		2.2	3.0		55.021	54.587
10:48:00	3:45		1.5	1.4		44.710	44.184
10:49:00	4:45		1.0	1.0		36.488	36.023
10:50:00	5:45		6.5	6.3	67	32.597	32.662
10:51:00	6:45	S	7.2	7.0	68	34.304	34.365
10:52:00	7:45		6.1	6.1		31.541	31.529
10:53:00	8:45		5.1	5.1		28.805	28.724
10:54:00	9:45		0	0		0.00	0.00

47.39

* S or B
 ** ③ 60°F and 1 atm

$Q = C \sqrt{\frac{\Delta P \rho}{460 T}}$ where ΔP is in "H₂O
 Q is in ACFM P is in psia T is in °F

C = 75.9687 ft³
 C = 218.4097 ft³

OUTLET ETO CONCENTRATION

TEST # 2 EVACUATION # 1 DATE 10/17/85

TIME	ELAPSED TIME (min)	CONCENTRATION (PPMV)
10:17	0	45.8
10:19	2	31.6
10:20	3	17.0
10:22	5	13.5
10:23	6	9.2
10:25	8	8.5
10:26	9	7.9
10:28	11	7.4
10:29	12	15.9

OUTLET ETO CONCENTRATION

TEST # 2 EVACUATION # 2 DATE 10/17/85

TIME	ELAPSED TIME (min)	CONCENTRATION (PPMV)
10:31	0	6.8
10:34	3	34.7
10:36	5	10.5
10:37	6	6.7
10:39	8	5.9
10:40	9	5.7
10:42	11	7.7
10:43	12	5.8

OUTLET ETO CONCENTRATION

TEST # 2 EVACUATION # 3 DATE 10/17/85

TIME	ELAPSED TIME (min)	CONCENTRATION (PPMV)
10:44:15	0	_____
10:45	0:45	69.6
10:46	1:45	30.9
10:48	3:45	10.1
10:50	5:45	5.7
10:51	6:45	5.2
10:53	8:45	5.7
10:54	9:45	2.5

A.6 REFERENCES

1. "Sampling/Analytical Method Evaluation for Ethylene Oxide Emission and Control Unit Efficiency Determinations." Draft Final Report. Radian Corporation, Research Triangle Park, North Carolina. February 1, 1988.
2. "Performance Testing Report: DEOXX™ Ethylene Oxide Detoxification System, McCormick & Company, Hunt Valley, Maryland Plant," Chemrox, Inc., 4695 Main Street, Bridgeport, Connecticut 06606. October 29, 1985.
3. "Evaluation of the Efficiency of an Ethylene Oxide Scrubber", Scott Environmental Services, Plumsteadville, Pennsylvania 18949. October 2, 1984.
4. "Certification Testing Report: Ethylene Oxide Detoxification System on Sterilizer No. 4, Chesebrough-Pond's, Inc., Sherburne, New York, Plant," Buonicore-Cashman Associates, Inc. 4695 Main Street, Bridgeport, Connecticut 06606. January 13, 1983.

APPENDIX B.

EMISSION MEASUREMENT AND CONTINUOUS MONITORING

B.1 EMISSION MEASUREMENT METHODS

The test method investigated by the U. S. Environmental Protection Agency (EPA) to measure ethylene oxide (EO) emissions combined rapid-fill Tedlar bag sampling with gas chromatographic/flame ionization detector analysis. In 40 CFR Part 60, Appendix B, Method 18: "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography," encompasses these techniques. The bag sampling procedure was chosen for field demonstration over rigid container sampling procedures because the bag is less prone to breakage, can be filled quickly for a grab-type sample, and contains sufficient sample for numerous repetitive analyses. However, other grab sampling procedures, such as a heated syringe, should be acceptable if they are adequately documented, and the quality assurance (QA) procedures of Method 18 are followed.

For the chromatographic analysis portion of Method 18, a column selected to optimize the resolution of ethylene oxide from dichlorodifluoromethane (CFC-12) was also field proven.

B.2 MONITORING DEVICES

There are several types of portable, self-contained instruments currently available for use as continuous emission monitoring devices in facilities with organic emissions. Some of the principles of detection are catalytic oxidation, flame ionization, photoionization, and infrared (IR) energy absorption. Of the four mentioned types of detection, both flame ionization and catalytic oxidation will respond to CFC-12, so in instances where EO is mixed with CFC-12, a monitoring device that employs either of those detectors must have provision for selectively exposing the detector to just EO, or the response will be meaningless. The EPA

publication number 340/1-80-010, "Summary of Available Portable Volatile Organic Compound Detection Instruments," provides further information on these and other portable detectors.

The costs of these monitoring devices range from \$1,000 to \$6,000, depending on the detection principle, operating features, and required accessories associated with the different instrument types and vendors. These costs could increase appreciably if EO must be resolved from CFC-12 before the sampled gas is exposed to the detector.

B.3 EMISSION TEST METHOD

If it is deemed necessary to conduct an emission test on the vent from an EO control device, then Method 18: "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography," is recommended as the performance test method. No particular problems with the use of Method 18 should occur, provided that strict adherence is made to the QA procedures.

A performance test consists of the arithmetic average EO concentration from the analysis of three test runs. Each test run consists of a rapid-fill bag sample collected from a sample port at the exit of the control device and commencing with the first evacuation of an EO filled chamber. The bag is rapidly filled immediately following a time period sufficient for flushing of the control device with sterilization chamber gas, and thus represents the highest concentration exiting the control device.

Studies of several types of chromatographic columns indicated that a stainless steel 3 meter (10 foot) by 3 millimeter (1/8 inch) outer diameter 5 percent Fluorocol on 60/80 mesh Carbopack B column provided the best conditions for separation of EO from CFC-12.

The cost for conducting a Method 18 performance test by a source testing contractor will depend on the length of the sterilization cycle and the distance to be travelled by testing personnel. An average figure is estimated to be \$7,500 for a single unit installation. Testing costs would be essentially unchanged regardless of the sampling technique used, due to the documentation and QA requirements that are a necessary part of a performance test method. Testing costs per affected facility would be lower if several facilities at a single site were tested consecutively.

APPENDIX C.
DESCRIPTION OF HUMAN EXPOSURE MODELING (HEM) AND SHORT-TERM
MODELING APPROACHES

C.1 DESCRIPTION OF THE HUMAN EXPOSURE MODEL

The HEM is a general model capable of estimating public exposure to ambient air concentrations of pollutants emitted from stationary sources. The HEM contains: (1) an atmospheric dispersion model, with included meteorological data, and (2) a population distribution estimate based on U.S. Bureau of Census data. The only input data needed to operate this model are source data. The specific data required include emission rate, stack parameters, and plant locations. A more extensive discussion of HEM can be found in the HEM User's Manual, (EPA-450/5-86-001, June 1986).

Based on the source data, the model estimates the magnitude and distribution of ambient air concentrations of the pollutant in the vicinity of the source. The model is programmed to estimate these concentrations within a radial distance of 50 kilometers (km) (30.8 miles) from the source. The selection of 50 km (30.8 miles) as the programmed distance is based on modeling considerations, not on health effects criteria. The dispersion model contained in HEM is believed to be reasonably accurate for radial distances up to 50 km (30.8 miles). If the user wishes to use a dispersion model other than the one contained in HEM to estimate ambient air concentrations in the vicinity of a source, HEM can accept the concentrations if they are appropriately formatted.

Based on the radial distance specified, HEM combines numerically the distributions of pollutant concentrations and population to produce quantitative expressions of public exposure to the pollutant.

Analyses of the HEM decay rate parameter indicate that only atmospheric lifetimes of approximately 4 hours or less can significantly decrease concentrations within 50 km (30.8 miles). As a consequence, decay factors are considered only for chemicals with atmospheric lifetimes of 4 hours or less. The atmospheric lifetime of EO is estimated to be from 0.6 to 1.5 years.¹

C.1.1 Pollutant Concentrations Near a Source

The dispersion model within the HEM is a Gaussian diffusion model. The algorithm is evaluated for a representative set of input values as well as actual plant data, and the concentrations input into the exposure algorithm are arrived at by interpolation. Stability array (STAR) summaries are the principal meteorological input to the HEM dispersion model. The STAR data are standard climatological frequency-of-occurrence summaries formulated for use in the EPA models and are available for major U.S. meteorological monitoring sites from the National Climatic Center, Asheville, North Carolina.

A STAR summary is a joint frequency-of-occurrence of wind speed, atmospheric stability, and wind direction, classified according to Pasquill's stability categories. The STAR summaries in HEM usually reflect 5 years of meteorological data for each of 314 sites nationwide. The model produces polar coordinate receptor grid points consisting of 10 downwind distances located along each of 16 radials which represent wind directions. Concentrations are estimated by the dispersion model for each of the 160 receptors located on this grid. The radials are separated by 22.5-degree intervals beginning with 0.0 degrees and proceeding clockwise to 337.5 degrees. The 110 downwind distances for each radial are 0.2, 0.5, 1.0, 1.0, 5.0, 10.0, 20.0, 30.0, 40.0, and 50.0 km. The center of the receptor grid for each plant is assumed to be the plant center.

C.1.2 The Population Living Near an Emission Source

To estimate the number and distribution of people residing within 50 km (30.8 miles) of each plant, the model contains the master area reference file (MARF) for 1980 from the U.S. Census Bureau. This data base is broken down into enumeration district/block group (ED/BG) values. It contains the population centroid coordinates (latitude and

longitude) and the 1980 population of each ED/BG in the U.S. (50 States plus the District of Columbia). The HEM identifies the population around each plant by using the geographical coordinates of the plant. The HEM then identifies, selects, and stores for later use those ED/BG's with coordinates falling within 50 km (30.8 miles) of plant center.

C.1.3 Population Exposure Determinations

The HEM uses the estimated ground level concentrations of a pollutant together with population data to calculate public exposure. For each of 160 receptors located around a plant, the concentration of the pollutant and the number of people estimated by the HEM to be exposed to that particular concentrations are identified. The HEM multiplies these two numbers to produce exposure estimates and sums these products for each plant.

A two-level scheme was adopted in order to pair concentrations and populations prior to the computation of exposure. The two-level approach is used because the concentrations are defined on a radius-azimuth (polar) grid pattern with nonuniform spacing. At small radii, the grid cells are usually smaller than ED/BG's; at large radii, the grid cells are usually larger than ED/BG's. The area surrounding the source is divided into two regions, and each ED/BG is classified by the region in which its centroid lies. Population exposure is calculated differently for the ED/BG's located within each region. For ED/BG centroids located between 0.1 km (0.06 miles) and 3.5 km (2.2 miles) from the emission source, populations are divided between neighboring concentration grid points. There are 64 (4x16) polar grid points within this range. Each grid point has a polar sector defined by two concentric arcs and two wind direction radials. Each grid point and its respective concentrations are assigned to the nearest ED/BG centroid identified. Each ED/BG can be paired with one or many concentration points. The population associated with the ED/BG centroid is then divided among all concentration grid points assigned to it. The land area within each polar sector is considered in the apportionment.

For population centroids between 3.5 km (2.2 miles) and 50 km (30.8 miles) from the source, a concentration grid cell, the area approximating a rectangular shape bounded by four receptors, is much

larger than the area of a typical ED/BG. Since there is an approximate linear relationship between the logarithm of concentration and the logarithm of distance for receptors more than 2 km (1.2 miles) from the source, the entire population of the ED/BG is assumed to be exposed to the concentration that is logarithmically interpolated radially and arithmetically interpolated azimuthally from the four receptors bounding the grid cell.

Concentration estimates for 96 (1x16) grid cell receptors at 5.0, 10.0, 20.0, 30.0, 40.0, and 50.0 km from the source along each of 16 wind directions are used as reference points for this interpolation.

In summary, two approaches are used to arrive at coincident concentration/population data points. For the 64 concentration points within 3.5 km (2.2 miles) of the source, the pairing occurs at the polar grid points using an apportionment of ED/BG population by land area. For the remaining portions of the grid, pairing occurs at the ED/BG centroids themselves through the use of log-log and linear interpolation.

C.1.4 Modeling Procedure

In general, the input data for the ethylene oxide health risk analyses were provided to the Agency by facilities in response to requests for information under Section 114 of the Clean Air Act and a survey conducted by the Health Industry Manufacturers Association (HIMA).

Aggregate human health risks or annual incidence, due to exposure near each point source of ethylene oxide, are calculated by multiplying the average ambient concentration of ethylene oxide ($\mu\text{g}/\text{m}^3$) times the number of people exposed times the unit risk factor (risk of cancer incidence/ $\mu\text{g}/\text{m}^3$) divided by 70 years. The unit risk factor is the probability that an individual will develop a ethylene oxide-related cancer when exposed to a concentration of 1 $\mu\text{g}/\text{m}^3$ of ethylene oxide for 70 years. The unit risk factor for ethylene oxide is 1.0×10^{-4} . Maximum individual risk is calculated by multiplying the maximum concentration ($\mu\text{g}/\text{m}^3$) to which any individual is exposed by the same unit risk factor.

C.2 DESCRIPTION OF THE SHORT-TERM MODELING APPROACH

C.2.1 Description of Industrial Source Complex Model

The Industrial Source Complex Short Term (ISCST) model is a steady-state Gaussian plume model which can be used to assess pollutant

concentrations from a wide variety of sources associated with an industrial source complex. It can account for point, area, line, and volume sources; downwash; deposition of particles; and limited terrain adjustments. Average concentrations or total deposition may be calculated for 1-, 2-, 3-, 4-, 6-, 8-, and/or 24-hour time periods.

The source data required to run ISCST include source location, emission rate, physical stack height, exit velocity, inside stack diameter, and exit temperature. For area, line, and volume sources, the input data may vary slightly from point sources. Specifically, for an area source, the width of the emission area would be input in place of the stack diameter.

Meteorological data are also a part of the inputs to the model. The ISCST requires hourly surface weather data from the preprocessor program RAMMET. This includes hourly stability class, wind direction, wind speed, temperature, and mixing height. If site-specific data is not available, the hourly data can be read from formatted cards.

The concentrations can be estimated at various receptor locations chosen by the user. Either a rectangular or polar grid system can be selected. Discrete or arbitrarily placed receptor points also can be included. For terrain adjustments, the receptor ground elevation may be input as well.

For regulatory applications, the model contains a regulatory default option. This will automatically select certain options, such as stack tip downwash, final plume rise, buoyancy induced dispersion, and a building downwash algorithm. The Guideline on Air Quality Models (EPA-450/2-78-027R) provides a brief description of the model's applications and functions, if more information is necessary.

C.2.2 Short-Term Modeling

In the short-term modeling analysis of ethylene oxide emissions, concentrations were estimated for 15-minute and 8-hour time periods. The ISCST model was applied with the regulatory default option and urban mode set.

For the analysis of the six unit sterilization facility, a rectangular receptor grid system was used. This included 392 receptor points on 6 rings concentric with the facility with the origin at the

center of the plant. For the analysis of one unit, a polar receptor grid of 8 distances and 36 directions was used with the origin at the largest source.

As no specific location was given, a set of prototypical meteorological data were input. This set was read from formatted cards and included 104 days of possible wind speed, wind direction, and stability class combinations.

Mentioned in the input data provided by ESD, the releases occurred in an intermittent fashion. This behavior was included in the estimation of the maximum concentrations. The ISCST provided 1-hour concentrations assuming the source emitted continuously over the 1-hour period. These estimates were adjusted to the 15-minute and 8-hour averaging times using a power law procedure based on release duration and stability class. The exponents used are based on Briggs (1973). A document prepared for SRAB under contract number 60-02-4351 provides more detail on the steps of this adjustment technique.

C.3 REFERENCE FOR APPENDIX C

1. Cupitt, L. T., 1987. Atmospheric Persistence of Eight Air Toxics. Final Report. U. S. Environmental Protection Agency, Research Triangle Park, North Carolina. Atmospheric Sciences Research Laboratory. EPA Report No. EPA/600/3-87/004-INTS No. PB87-145306/XAB.

APPENDIX D.
COST INDICES AND CONVERSION FACTORS USED
FOR COST CALCULATIONS

The prices for the scrubbers, vacuum pump, chlorine filters, and chemicals were obtained from the manufacturers and suppliers and were originally in 1986 dollars. These prices were converted to 4th quarter 1984 dollars using the following indices from Chemical Engineering:

	<u>February 1986¹</u>	<u>October 1984²</u>	<u>Conversion factor</u>
<u>CE Plant Cost Index</u>			
Scrubber	319.2	335.1	1.05
Vacuum pump	418.6	413.1	0.987
Explosion-proof valves	377.1	382.9	1.015
Chlorine filters	344.1	334.7	0.98
<u>Current Business Indicators</u>			
Industrial chemicals	340.0	334.7	0.98

The labor costs were calculated using the GARD Manual and the annual CE Plant Cost Indices in Chemical Engineering:

<u>CE Plant Cost Index¹</u>	
1978	218.8
1984	322.7
Conversion factor	1.47
GARD Manual ³	\$7.87/person-hour
Labor for calculations	\$11.60/person-hour

REFERENCES FOR APPENDIX D

1. Chemical Engineering. Economic Indicators. June 23, 1986. p. 7.
2. Chemical Engineering. Economic Indicators. February 18, 1985. p. 7.
3. Neveril, R., Capital and Operating Costs of Selected Air Pollution Control Systems. GARD, Inc. Niles, Illinois. Publication No. EPA-450/5-80-002. December 1978. p. 3-11, 12, 16.

APPENDIX E.
ASSUMPTIONS AND SAMPLE CALCULATIONS FOR
BASELINE CATEGORIES I AND II

EXAMPLE CALCULATIONS FOR BASELINE CATEGORY I¹

In this example, the facility has an existing flare controlling the vent exhaust that reportedly achieves an efficiency of at least 98 percent. Control to achieve regulatory compliance would consist of installing closed-loop recirculation vacuum pumps on the drains of all chambers and controlling drain emissions with the existing control device. Tables E-1 and E-2 present the example calculations for baseline E0 emissions and incremental control costs, respectively.

The selected facility has four sterilizer chambers. Three chambers each use 70,700 lb of pure E0 per year. The fourth chamber uses 3,597 lb of pure E0 per year. This chamber also uses 97 pounds of E0 in a 12/88 (E0/CFC-12) mixture that is vented directly to the atmosphere. No additional control of the emissions from the 12/88 mixture was considered because combusting 12/88 mixtures would cause toxic secondary emissions.

Drain emissions at baseline are assumed to be 45 percent of total E0 use, and vent emissions at baseline are assumed to be 50 percent of total E0 use multiplied by 0.01 (i.e., $1-0.99$). The 97 pounds of emissions from use of the 12/88 mixture are not included because they will not be controlled.

The only capital cost would be for installing closed-loop recirculation vacuum pumps on each of the four chambers. The annual cost would consist of the capital recovery charge and costs for taxes, insurance, and administration. There would be no additional charge for labor and overhead because the recirculating vacuum pumps do not have any additional labor requirements with respect to the once-through vacuum pumps already in use.

To calculate the incremental cost effectiveness, the annualized cost is divided by the emission reduction. The emission reduction is calculated by subtracting E0 emissions after control to achieve regulatory compliance from the uncontrolled E0 emissions at baseline. The E0 emissions after control are equal to 95 percent (vent plus drain) of total E0 use multiplied by 0.01 (or 0.93 Mg of E0).

EXAMPLE CALCULATIONS FOR BASELINE CATEGORY II¹

In this example, the facility has an existing high-efficiency acid/water scrubber (99 percent) controlling the vent exhaust from the two larger chambers. Implementing control to achieve regulatory compliance would require manifolding the two smaller chambers to the existing control device and installing closed-loop recirculation vacuum pumps on all four chambers to eliminate drain emissions. Example calculations for EO emissions and incremental control costs for the facility are presented in Tables E-3 and E-4, respectively.

For the selected facility, there are four sterilizer chambers. Two chambers each use 42,000 lb of EO per year (lb/yr), one chamber uses 24 lb/yr, and the other chamber uses 6 lb/yr, for a total EO use of 84,030 lb/yr. Emissions from the vent and drain are 17.35 Mg at baseline and would be 0.36 Mg after control, resulting in an emission reduction of 16.99 Mg.

The capital costs for this facility are the costs to install closed-loop recirculation pumps on each of the four chambers and the costs to manifold the two smaller chambers to the existing control device.

Annualized costs would include the additional costs for the chemicals and disposal. It was assumed that the scrubber uses a 10 percent sulfuric acid solution. The procedures for costing the chemicals and disposal charges are the same as those presented in Appendix F.

The capital recovery factor is based on 16.275 percent of total installed capital costs; taxes, insurance, and administration are 4 percent of the capital costs.

To calculate the incremental cost effectiveness, the annualized cost is divided by the emission reduction.

REFERENCE FOR APPENDIX E

1. Memorandum from Srebro, S., MRI, to Markwordt, D., EPA/CPB. March 20, 1987. Capital cost, annualized cost, and cost effectiveness of reducing ethylene oxide emissions at commercial sterilization facilities.

TABLE E-1. ETHYLENE OXIDE USE AND EMISSIONS¹

Chamber	EO-use	Chamber use and emissions			MEO- emit	EO-fac	MEO- fac	Facility use and emissions		
		Drain	Vent	EO-emit				EO-tot	MEO- tot	Reduce
1	70,700	31,815	353.5	32,168	14.43	98,096	44.49	215,600	97.79	43.56
2	70,700	31,815	353.5	32,168	14.43	98,096	44.49	215,600	97.79	43.56
3	70,700	31,815	353.5	32,168	14.43	98,096	44.49	215,600	97.79	43.56
4a	3,500	1,575	17.50	1,592	0.71	98,096	44.49	215,600	97.79	43.56
b	97									

Where:

EO-use = amount of EO used by the chamber per year, lb/yr
 Drain = emissions at baseline from chamber drain, lb/yr
 Vent = emissions at baseline from chamber vent, lb/yr
 EO-emit = emissions at baseline from chamber drain and chamber vent combined, lb/yr
 MEO-emit = emissions at baseline from chamber drain and chamber vent combined, lb/yr
 EO-fac = total emissions at baseline from facility, lb/yr
 MEO-fac = total emissions at baseline from facility, lb/yr
 EO-tot = total EO used at facility, lb/yr
 MEO-tot = total EO used at facility, lb/yr
 NESHAP = emissions of EO from facility after control, Mg/yr
 Reduce = emissions of EO controlled at facility after control, Mg/yr, i.e., (MEO-fac)-(NESHAP)

TABLE E-2. CAPITAL AND ANNUALIZED COSTS OF INSTALLING SCRUBBERS¹
(4th Quarter 1984 Dollars)

Item	Cost
I. CAPITAL COSTS^a	
<u>Installed equipment costs, 1984, \$</u>	
Automated scrubber	N/A ^b
Explosion-proof valves for scrubber	b
Chlorine filter house	b
Purchased equipment costs, total	b
Installation of scrubber	b
Installation of chlorine filters	b
Taxes: 5 percent of equipment cost	b
Freight: 5 percent of equipment cost	b
Vacuum pump ^c	19,700
Manifolding of chambers (includes check valve)	b
Total capital costs, 1984, \$	19,700
II. ANNUALIZED COSTS^a	
<u>Direct operating costs, 1984, \$</u>	
Labor ^b	b
Materials	
50 percent H ₂ SO ₄	
50 percent NaOH	b
Chlorine filters	b
Taxes: 5 percent of materials cost	b
Freight: 5 percent of materials cost	b
Compressed air	b
Disposal of ethylene glycol	b
<u>Indirect operating costs, 1984, \$</u>	
Overhead: 0.80 x labor	b
Property tax, insurance, and administration ^e	788
Capital recovery costs ^c	3,210
TOTAL ANNUALIZED COSTS, 1984, \$	4,000
III. COST EFFECTIVENESS	
Reduce, Mg EO yr	43.56
Cost effectiveness, 1984, \$/Mg EO	92

(continued)

TABLE E-2. (continued)

^aRounded to three significant figures.

^bNot applicable.

^cFour vacuum pumps at \$4,935 each.

^dLabor was calculated for 0.25 person-hours/shift, 3 shifts/day, 365 days/year for system inspection and 16 person-hours for each regeneration of the scrubber at \$11.60/person-hour.

^eCalculated as 4 percent of total capital cost.

^fCalculated as $0.16275 \times (\text{total capital costs})$, i.e., for an interest rate of 10 percent and a 10-year recovery period.

TABLE E-3. ETHYLENE OXIDE USE AND EMISSIONS¹

Chamber	EO-use	Chamber use and emissions			MEO- emit	EO-emit	MEO- fac	Facility use and emissions		
		Vent	Drain	EO-emit				EO-tot	MEO- tot	NESHAP Reduce
1	42,000	210	18,900	19,110	8.57	38,249	17.35	84,030	38.11	0.36
2	42,000	210	18,900	19,110	8.57	38,249	17.35	84,030	38.11	0.36
3	24	12	10.8	22.8	0.01	38,249	17.35	83,030	38.11	0.36
4	6	3	2.7	5.7	0.002	38,249	17.35	84,030	38.11	0.36

Where:

EO-use = amount of EO used by the chamber per year, lb/yr
 Drain = emissions at baseline from chamber drain, lb/yr
 Vent = emissions at baseline from chamber vent, lb/yr
 EO-emit = emissions at baseline from chamber vent, lb/yr
 MEO-emit = emissions at baseline from chamber drain and chamber vent combined, lb/yr
 EO-fac = total emissions at baseline from chamber drain and chamber vent combined, Mg/yr
 MEO-fac = total emissions at baseline from facility, lb/yr
 EO-tot = total EO used at facility, lb/yr
 MEO-tot-total EO used at facility, Mg/yr
 NESHAP = emissions of EO from facility after control, Mg/yr
 Reduce = emissions of EO controlled at facility after control, Mg/yr, i.e., (MEO-fac) - (NESHAP)

TABLE E-4. CAPITAL AND ANNUALIZED COSTS OF INSTALLING SCRUBBERS¹
(4th Quarter 1984 Dollars)

Item	Cost
<u>I. CAPITAL COSTS^a</u>	
<u>Installed equipment costs, 1984, \$</u>	
Automated scrubber	N/A ^b
Explosion-proof valves for scrubber	b
Chlorine filter house	b
Purchased equipment costs, total	b
Installation of scrubber	b
Installation of chlorine filters	b
Taxes: 5 percent of equipment cost	b
Freight: 5 percent of equipment cost	b
Vacuum pump ^c	19,700
Manifolding of chambers (includes check valve) ^d	4,600
Total capital costs, 1984, \$	24,300
<u>II. ANNUALIZED COSTS</u>	
<u>Direct operating costs, 1984, \$</u>	
Labor ^e	b
Materials	
50 percent H ₂ SO ₄ ^f	784
50 percent NaOH ^g	706
Chlorine filters	b
Taxes: 5 percent of materials cost	74
Freight: 5 percent of materials cost	74
Compressed air	0
Disposal of ethylene glycol ^h	5,470
<u>Indirect operating costs, 1984, \$</u>	
Overhead: 0.80 x labor	b
Property tax, insurance, and administration ⁱ	972
Capital recovery costs ^j	3,950
TOTAL ANNUALIZED COSTS, 1984, \$	12,000
<u>III. COST EFFECTIVENESS</u>	
Reduce, Mg EO yr	16.99
Cost effectiveness, 1984, \$/Mg EO	710
(continued)	

TABLE E-4. (continued)

-
- ^aRounded to three significant figures.
 - ^bNot applicable.
 - ^cFour vacuum pumps at \$4,935 each.
 - ^dManifolding the two smaller chambers to the larger chambers at \$2,300 each chamber.
 - ^eLabor was calculated for 0.25 person-hours/shift, 3 shifts/day, 365 days/year for system inspection and 16 person-hours for each regeneration of the scrubber at \$11.60/person-hour. (No. of regenerations= $\text{eo-fac} \div 2,000 \times \text{No. tanks}$).
 - ^fThe cost of acid is calculated, $\text{eo-fac} \div 2,000 \times 594 \times \0.069 .
 - ^gThe cost of caustic is calculated, $\text{No. drum} = \text{eo-fac} \div 2,000 \times 250 \div 350$. $\text{No. drum} = 13.66$; therefore, unit cost = \$0.0738. Total cost = $\text{No. drums} \times 700 \times \0.0738 .
 - ^hDisposal cost is $\text{eo-fac} \div 2,000 \times 4,845 \times \0.0059 .
 - ⁱCalculated as 4 percent of total capital cost.
 - ^jCalculated as $0.16275 \times (\text{total capital costs})$, i.e., for an interest rate of 10 percent and a 10-year recovery period.

APPENDIX F.
ASSUMPTIONS AND SAMPLE CALCULATIONS FOR
BASELINE CATEGORIES III AND IV

EXAMPLE CALCULATIONS FOR BASELINE CATEGORY III¹

In this example, the facility has an existing low-efficiency control device (a reclamation device) controlling the vent exhaust from the two chambers at a reported efficiency of 50 percent. Implementing control to achieve regulatory compliance would consist of installing closed-loop recirculation vacuum pumps on both chambers to eliminate drain emissions and installing a 99 percent efficient scrubber to control drain emissions and emissions not controlled by the existing control device.

	Chamber No. 1	Chamber No. 2
Size, ft ³	1,000	1,000
Gas type	12/88	12/88
E0 use, lb/yr	31,800	31,800
Control	0.50	0.50
E0 emit, lb/yr	22,260	22,260
ME0 emit, Mg/yr	10.097	10.097

E0 fac 44,520 lb/yr
 ME0 fac 20.194 Mg/yr
 E0 tot = 63,600 lb/yr
 ME0 tot = 28.849 Mg/yr
 NESHAP = 0.274 Mg/yr
 Reduce = 19.920 Mg/yr

1. The size, gas type, E0 use, and control were taken directly from the facility's response to the HIMA survey on E0 use. The other values were calculated using the following assumptions:

a. E0 emit (lb) = E0 (lb) emitted annually from the sterilization chamber to the vacuum pump drain and to the atmosphere at baseline. Residual E0 in the sterilized product was assumed to be 5 percent of E0 use (lb). This 5 percent of the E0 use is not included as part of E0 emit. Chamber drain emissions were assumed to be 45 percent of E0 use (lb). The amount of E0 vented to the atmosphere from the existing control device was assumed to equal $[(1-\text{control}) \times 0.50 \text{ E0 use (lb)}]$. E0 emit = drain+vent

b. ME0 emit (Mg E0) = E0 emit (lb)/2,204.6

c. E0 fac (lb) and ME0 fac (Mg) are the amount of E0 released annually by the facility to the vacuum pump drain and to the atmosphere at baseline, i.e., the sum of E0 emit and ME0 emit, respectively.

d. EO-tot (lb) is the total amount of EO (lb) used annually by the facility, i.e., the sum of EO use. $\text{MEO-tot (Mg)} = \text{EO-tot (lb)} / 2,204.6$.

e. NESHAP (Mg) is the amount of EO that would be released annually after control, i.e., $\text{MEO-TOT} * (1 - 0.99) * 0.95$. Note that the 5 percent residual EO in the sterilized product, which is later released from the aeration room vent, is excluded from this calculated emission estimate.

f. Reduce (Mg) is the incremental amount of EO that would be reduced if controls are implemented, i.e., $(\text{MEO-fac}) - (\text{NESHAP})$.

2. For all calculations, a conversion efficiency of 99.0 percent was assumed for the scrubber.

3. Each tank of the scrubber initially holds 198 gal H_2O and 19.8 gal H_2SO_4 . The manufacturer recommends that the tank be regenerated (i.e., drained, rinsed, and refilled) after 2,000 lb EO have been treated.

a. 19.8 gal $\text{H}_2\text{SO}_4 = 1.42 \text{ kg-mole } \text{H}_2\text{SO}_4$ ($\rho = 1.834$; $\text{MW} = 98.08$)
 $2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O}$; 1.42 kg-mole H_2SO_4 requires 2.84 kg mole NaOH to neutralize. Neutralization will produce 2.84 kg-moles H_2O and 1.42 kg mole Na_2SO_4 . Use 50 percent (w/w) NaOH to neutralize; each 55-gal drum of 50 percent NaOH weighs 700 lb, i.e., 350 lb NaOH; need 2.84 kg-moles or 250 lb NaOH to neutralize.

b. $\text{C}_2\text{H}_4\text{O (EO)} + \text{H}_2\text{O} \rightarrow \text{C}_2\text{H}_4(\text{OH})_2$ (ethylene glycol); 2,000 lb EO = 20.51 kg-moles EO ($\text{MW} = 44.1$).

c. At 99 percent conversion yield is 20.365 kg-moles or 301 gal ethylene glycol (EG) ($\text{MW} = 62.07$; $\rho = 1.1088$).

d. At 99 percent conversion, 20.571 kg-moles H_2O have reacted. 41.64 kg moles H_2O originally available ($\text{MW} = 18$; $\rho = 1$); 21.07 kg-moles or 100 gal H_2O remain unreacted.

e. Weight of neutralized solution per tank: 1.42-kg mole $\text{Na}_2\text{SO}_4 = 202 \text{ kg } \text{Na}_2\text{SO}_4$ ($\text{MW} = 142.04$); 2.84 kg-moles H_2O (from neutralization) = 51 kg H_2O ; 250 lb (113 kg) $\text{H}_2\text{O} =$ from 50 percent NaOH solution; 100 gal unreacted $\text{H}_2\text{O} = 378 \text{ kg } \text{H}_2\text{O}$; 301 gal EG = 1,264 kg EG; total wt = 2,008 kg = 4,427 lb.

f. Solution is 63 percent (w/w) EG. Add about 50 gal rinse water for each tank = 189 kg; total wt (+rinse H_2O) = 4,844 lb; total gal (+rinse H_2O) = 495 gal = 9 55-gal drums; wt per 55-gal drum = 538 lb.

4. Find scrubber model and cost from Table 7-1, using volume of largest chamber.

Chamber 1 1,000 ft³ Model 400 \$99,750

Piping costs for manifolding were not calculated because both chambers are manifolded to the existing control device.

5. Gas type = 12/88; explosion-proof valves not necessary

6. Find number of regenerations of scrubber required per year:

a. Number of tanks = scrubber model/100 = 4

b. Conversion capacity of scrubber = (no. of tanks)x2,000 lb = 8,000 lb

c. Number of regenerations = EO-fac (lb)/8,000, i.e., the amount of EO (lb) to be treated per year divided by the conversion capacity of the scrubber.

Chambers 1 and 2 44,520/8,000 = 5.57 regenerations/yr

7. Cost of chlorine filter housing = (41.50)x(no. of tanks) = \$166.00

8. Installation costs:

a. Scrubber installation = (0.5)x(cost of scrubber) = \$49,875

b. Chlorine filter housing installation = (20)x(no. of tanks) = \$80

9. Vacuum pump. A vacuum pump is required on both of the chambers. The cost of the first vacuum pump is included in the cost of the scrubber; only one is costed separately at \$4,935.

10. Calculate direct operating costs:

a. Labor = 3,177+(11.60)x(16)x(no. of regenerations). The \$3,177 is for general inspection of the system 15 minutes/shift, 3 shifts/day, 365 days/yr at \$11.60/person-hour. For the purposes of these cost analyses, it was assumed that each regeneration of the scrubber would require 2 people at 8 person-hours each, independent of scrubber size. System inspection was also assumed to be independent of scrubber size.

b. Sulfuric acid (50 percent H₂SO₄-electrolyte grade). Assumed: 1 55-gal drum 50 percent H₂SO₄, i.e., 19.4 gal H₂SO₄, per scrubber tank.

No. of drums required = eo-fac/2,000

Cost of acid = (no. of drums)x(594 lb/drum)x(\$0.069/lb)

c. Caustic (50 percent NaOH-industrial grade). Unit cost of NaOH was calculated by first dividing total amount of EO (lb) per year to be

controlled at the facility by the conversion capacity of one tank, i.e., 2,000 lb E0, to find the total no. tanks/yr.

$$E0 \text{ fac}/2,000 = 44,520/2,000 = 22.26 = \text{totanks}$$

$$250 \text{ lb NaOH required per tank} = 22.26 \times 250 = 5,565 \text{ lb/yr}$$

$$\text{Total drums/yr required by facility} = \text{total NaOH (lb)}/350 \text{ lb per drum; total drums} = 15.9$$

$$\text{If total drums} > 9, \text{ cost/lb} = 0.0738$$

$$\text{If total drums} = 3 \text{ to } 9, \text{ cost/lb} = 0.0787$$

$$\text{If total drums} = < 2, \text{ cost/lb} = 0.108$$

$$\text{Cost of caustic} = (\text{no. of drums}) \times (\text{cost/lb}) \times (700 \text{ lb/drum})$$

d. Cost of chlorine filters. Each filter can dechlorinate ~200 gal H₂O (or 1 tank); replace at each regeneration.

$$\text{Cost} = (\text{no. of regenerations}) \times (\text{no. of tanks}) \times (\$15/\text{filter})$$

e. Disposal. Unit cost of disposal was calculated by multiplying the total number of tanks/year, i.e., totanks (see 10.c.) by the weight of a tank at the time of regeneration, including rinse water (see 3.f).

$$\text{total wt } 22.26 \times 4,844 \text{ lb/tank} = 107,827 \text{ lb/yr}$$

$$\text{If total wt} < 42,000 \text{ lb, disposal cost} = \text{wt (lb)} \times (\$0.096/\text{lb})$$

$$\text{If total wt} \geq 42,000 \text{ lb, disposal cost} = \text{wt (lb)} \times (\$0.059/\text{lb})$$

f. Compressed air. The cost of 10 seconds of in-house air per cycle was considered negligible and was not computed for these cost analyses.

11. The capital and annualized costs are reported in Table F-1.

TABLE F-1. CAPITAL AND ANNUALIZED COSTS OF INSTALLING SCRUBBERS¹
(4th Quarter 1984 Dollars)

Item	Cost
<u>I. CAPITAL COSTS^a</u>	
<u>Installed equipment costs, 1984, \$</u>	
Automated scrubber ^b	99,800
Explosion-proof valves for scrubber	N/A ^c
Chlorine filter house ^d	166
Purchased equipment costs, total	100,000
Installation of scrubber ^e	49,900
Installation of chlorine filters	80
Taxes: 5 percent of equipment cost	5,000
Freight: 5 percent of equipment cost	5,000
Vacuum pump ^f	4,940
Manifolding of chambers (includes check valve)	N/A
Total capital costs, 1984, \$	165,000
<u>II. ANNUALIZED COSTS^a</u>	
<u>Direct operating costs, 1984, \$</u>	
Labor ^g	4,210
Materials	
50 percent H ₂ SO ₄ ^h	912
50 percent NaOH ⁱ	821
Chlorine filters ^j	334
Taxes: 5 percent of materials cost	103
Freight: 5 percent of materials cost	103
Compressed air ^k	0
Disposal of ethylene glycol ^l	6,360
<u>Indirect operating costs, 1984, \$</u>	
Overhead: 0.80 x labor	3,370
Property tax, insurance, and administration ^m	6,600
Capital recovery costs ⁿ	26,900
TOTAL ANNUALIZED COSTS, 1984, \$	49,700
<u>III. COST EFFECTIVENESS</u>	
Reduce, Mg EO yr	19.9
Cost effectiveness, 1984, \$/Mg EO	2,500
(continued)	

TABLE F-1. (continued)

Item	Cost
^a Costs rounded to three significant figures.	
^b Based on largest chamber size of 1,000 ft ³ .	
^c Not applicable.	
^d One per tank at \$41.50 each.	
^e Fifty percent of scrubber cost.	
^f One at \$4,935. The cost of the first vacuum pump is included in the installation cost of the scrubber.	
^g Labor was calculated for 0.25 person-hours/shift, 3 shifts/day, 365 days/year for system inspection and 16 person-hours for each regeneration of the scrubber at \$11.60/person-hour.	
^h The cost of acid is calculated, $(eo-fac) \div (2,000) \times (594) \times (\$0.069)$.	
ⁱ The cost of caustic is calculated, No. drum = $(eo-fac) \div (2,000) \times (250) \div (350)$. No. drum = 15.9; therefore, unit cost = \$0.0738. Total cost = $(No. drums) \times (700) \times (\$0.0738)$.	
^j Chlorine filter cost is $(eo-fac) \times (15) \div (2,000)$.	
^k The cost of 10 seconds of house-supplied compressed air per cycle was considered negligible.	
^l Disposal cost is $(eo-fac) \div (2,000) \times (4,845) \times (0.059)$.	
^m Calculated as 4 percent of total capital costs.	
ⁿ Calculated as $(0.16275) \times (total\ capital\ costs)$ for an interest rate of 10 percent and a 10-year recovery period.	

EXAMPLE CALCULATIONS FOR CATEGORY IV¹

In this example, the facility has no existing control device. Control to achieve regulatory compliance would consist of manifolding the chambers to a 99 percent efficient scrubber and installing closed-loop recirculation vacuum pumps on all chambers.

	Chambers				
	No. 1	No. 2	No. 3	No. 4	No. 5
Size, ft ³	667	167	1,200	1,334	1,334
Gas type	100	100	12/88	100	100
EO use, lb	28,000	28,000	1,200	46,000	46,000
Control	0	0	0	0	0
EO-emit, lb	26,600	26,600	1,140	43,700	43,700
MEO-emit, Mg	12.07	12.07	0.52	19.82	19.82
EO-fac, lb	141,740				
MEO-fac, Mg	64.30				
EO-tot, lb	149,200				
MEO-tot, Mg	67.7				
NESHAP	0.64				
Reduce	63.66				

1.-3. See Baseline Scenario III for methodology.

4. Find scrubber model and cost from Table 7-1, based on the sum of the volumes of the two largest chambers at the facility.

Chambers 4 and 5 2,668 ft³ Model 600 \$157,500

5. Because four chambers use 100 percent EO, explosion-proof valves are necessary.

6-8. See example calculation for Baseline Scenario III for methodology

9. The incremental capital costs of manifolding are presented in Table 7-2.

10. Vacuum pumps. A vacuum pump is required on each of the five chambers. The cost of the first vacuum pump is included in the cost of the scrubber; therefore, only four vacuum pumps at \$4,935 each are costed separately.

11. See example calculation for Baseline Scenario III, Section 10 for methodology.

12. The capital and annualized costs are reported in Table F-2.

TABLE F-2. CAPITAL AND ANNUALIZED COSTS OF INSTALLING SCRUBBERS¹
(4th Quarter 1984 Dollars)

Item	Cost
<u>I. CAPITAL COSTS^a</u>	
<u>Installed equipment costs, 1984, \$</u>	
Automated scrubber ^b	158,000
Explosion-proof valves for scrubber ^c	18,300
Chlorine filter house ^d	249
Purchased equipment costs, total	177,000
Installation of scrubber ^e	79,000
Installation of chlorine filters	120
Taxes: 5 percent of equipment cost	8,850
Freight: 5 percent of equipment cost	8,850
Vacuum pump ^f	19,700
Manifolding of chambers (includes check valve) ^g	9,560
Total capital costs, 1984, \$	303,000
<u>II. ANNUALIZED COSTS^a</u>	
<u>Direct operating costs, 1984, \$</u>	
Labor ^h	5,370
Materials	
50 percent H ₂ SO ₄ ⁱ	2,900
50 percent NaOH ^j	2,620
Chlorine filters ^k	1,060
Taxes: 5 percent of materials cost	329
Freight: 5 percent of materials cost	329
Compressed air ^l	0
Disposal of ethylene glycol ^m	20,300
<u>Indirect operating costs, 1984, \$</u>	
Overhead: 0.80 x labor	4,300
Property tax, insurance, and administration ⁿ	12,100
Capital recovery costs ^o	49,300
TOTAL ANNUALIZED COSTS, 1984, \$	98,600
<u>III. COST EFFECTIVENESS</u>	
Reduce, Mg EO yr	63.66
Cost effectiveness, 1984, \$/Mg EO	1,500

(continued)

TABLE F-2. (continued)

- ^aCosts rounded to three significant figures.
- ^bBased on sum of two largest chambers.
- ^cOne set per scrubber at \$18,300 each.
- ^dOne per tank; six tanks; \$41.50 each.
- ^eFifty percent of scrubber cost.
- ^fThe cost of the first vacuum pump is included in the installation cost of the scrubber; therefore, four pumps at \$4,935 each.
- ^gSee Appendix C. Manifold four chambers at \$2,300 each plus \$355 for a check valve for the first chamber.
- ^hLabor was calculated for 0.25 person-hours/shift, 3 shifts/day, 365 days/year for system inspection and 16 person-hours for each regeneration of the scrubber at \$11.60/person-hour. No. of regenerations = $(eo-fac) \div (2,000) \times (\text{No. of tanks})$.
- ⁱThe cost of acid is calculated, $(eo-fac) \div (2,000) \times (594) \times (\$0.069)$.
- ^jThe cost of caustic is calculated, No. drum = $(eo-fac) \div (2,000) \times (250) \div (350)$. No. drum = 50.62; therefore, unit cost = \$0.0738. Total cost = $(\text{No. drums}) \times (700) \times (0.0738)$.
- ^kChlorine filter cost is $(eo-fac) \times (15) \div (2,000)$.
- ^lThe cost of 10 seconds of house-supplied compressed air per cycle was considered negligible.
- ^mDisposal cost is $(eo-fac) \div (2,000) \times (4,845) \times (0.059)$.
- ⁿCalculated as 4 percent of total capital costs.
- ^oCalculated as $(0.16275) \times (\text{total capital costs})$ for an interest rate of 10 percent and a 10-year recovery period.

REFERENCE FOR APPENDIX F

1. Memorandum from Srebro, S., MRI, to Markwordt, D., EPA/CPB. March 20, 1987. Capital cost, annualized cost, and cost effectiveness of reducing ethylene oxide emissions at commercial sterilization facilities.

APPENDIX G

SUBSTITUTION EFFECTS OF COMMERCIAL STERILIZATION NESHAP CONTROLS

APPENDIX G

SUBSTITUTION EFFECTS OF COMMERCIAL STERILIZATION NESHAP CONTROLS

This appendix utilizes a comparative statics approach to examine the potential substitution effects of the candidate NESHAP controls. Specifically, the analysis shows that a partial substitution of contract sterilization for in-house sterilization will likely occur if the candidate NESHAP controls are adopted.

In this analysis, "in-house" sterilization is the portion of total sterilization output that is performed onsite by firms as a part of the production process. All sterilization performed by medical equipment suppliers, other health-related suppliers, pharmaceutical manufacturers, spice manufacturers, museums and libraries, and laboratories is considered "in-house" sterilization. Contract sterilization is the portion of total sterilization output provided by facilities in the contract sterilizers group.

Figure G-1 shows sterilization supply curves for contract sterilization (S-C) and in-house sterilization (S-IH). These supply curves relate the marginal cost of sterilization to the quantity of goods sterilized per unit of time for contract sterilizers and in-house sterilizers, respectively. The upward slope indicates that the marginal cost of sterilization rises as facilities try to sterilize more goods.

The supply curve for contract sterilization (S-C) intersects the vertical axis at a higher value than the supply curve for in-house sterilization (S-IH). The distance between the two curves, AP^* , represents the additional per-unit costs of contract sterilization over the cost of in-house sterilization. These additional costs include: the cost of transporting products to and from the contract sterilizer, the inventory cost of products while in-transit, the reliability and negotiation costs of dealing with an outside supplier, and the cost of products damaged or not properly

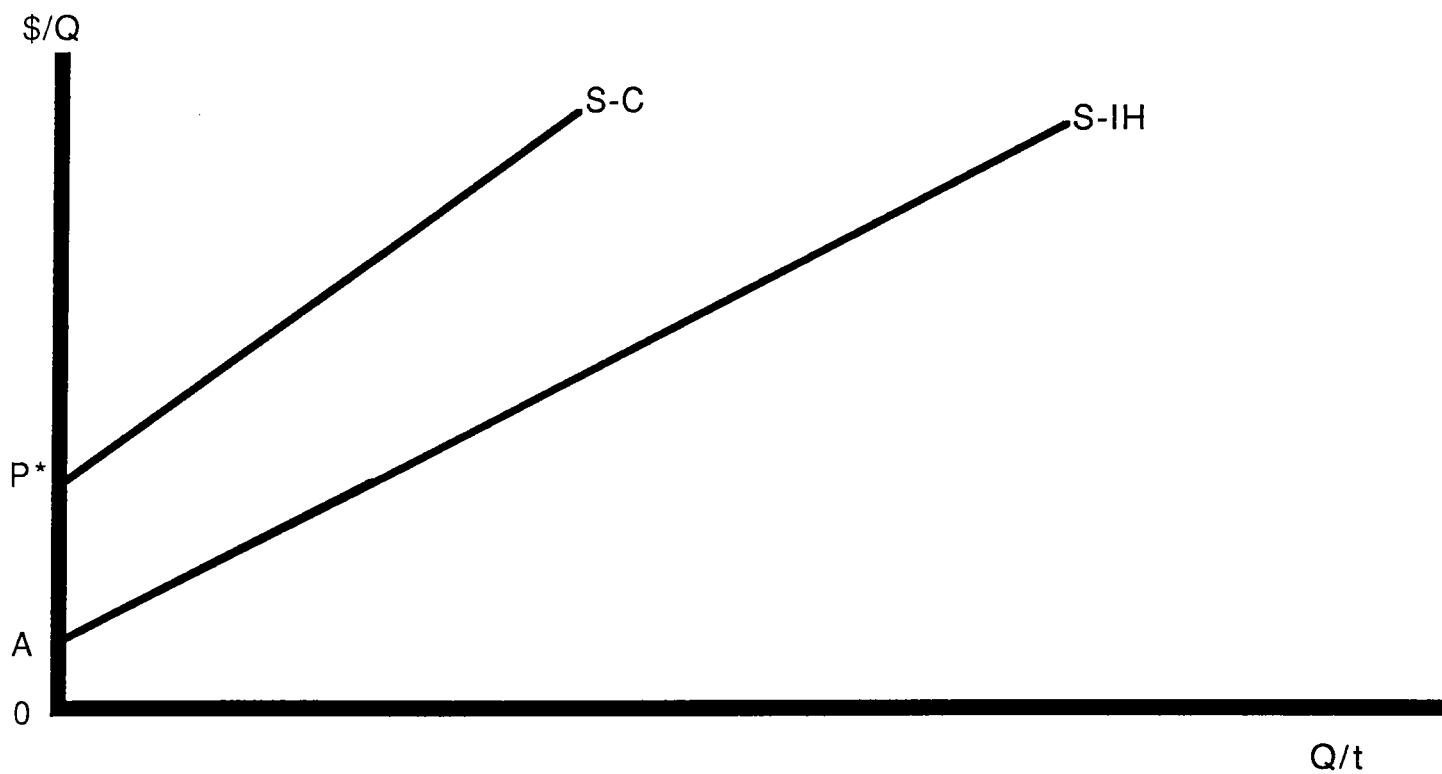


Figure G-1. Supply curves for contract sterilization (S-C) and in-house sterilization (S-IH).

sterilized by the contract sterilizer. For simplicity, we refer to these additional costs as transportation costs.

As shown in Figure G-2, the market supply curve for sterilization (S-M) is the horizontal summation of the supply curves for contract and in-house sterilization (S-C and S-IH, respectively).^{*} At all price levels below P^* , the market supply curve equals the in-house supply curve. Below P^* , no products are sterilized by contract sterilizers due to the transportation costs discussed above. At some arbitrary price, P_o , contract sterilizers will sterilize quantity P_oD , while in-house sterilizers will sterilize quantity P_oE . Since contract sterilizers and in-house sterilizers constitute the entire sterilization market, the market quantity at price P_o will be the sum of the quantities produced by the two groups, i.e., P_oF .

In Figure G-3 we superimpose the derived demand for sterilization, DD-M, on the supply curves from Figure G-2. Market equilibrium occurs at price P_o and quantity Q-M, the intersection of the market supply curve, S-M, and the market demand curve, DD-M. Contract and in-house sterilizers act as price takers, being unable to affect the market price, P_o . The quantity of goods sterilized by contract or in-house sterilization (OQ-C or OQ-IH, respectively) is determined by the intersection of P_o and the appropriate supply curve (Q-C for contract sterilization and Q-IH for in-house sterilization). In equilibrium, the marginal cost of contract sterilization, including transportation costs, will equal the marginal cost of in-house sterilization.

Figure G-4 illustrates the production cost increases that would be caused by the candidate NESHAP controls. Each supply curve would shift upward by the amount of the average total annualized cost (TAC) per unit of product sterilized. So S-C would shift upward to S-C', S-IH would shift upward to S-IH', and S-M would shift upward to S-M'. As shown in this figure, it is likely that the supply curve for contract sterilization would shift upward by a smaller amount than the shift in the supply curve for in-house sterilization. This may be attributed to a lower average TAC per unit of product sterilized for contract sterilizers due to economies of

^{*}The S-C and S-IH curves are also horizontal summations of the supply curves of individual contract and in-house sterilizers, respectively.

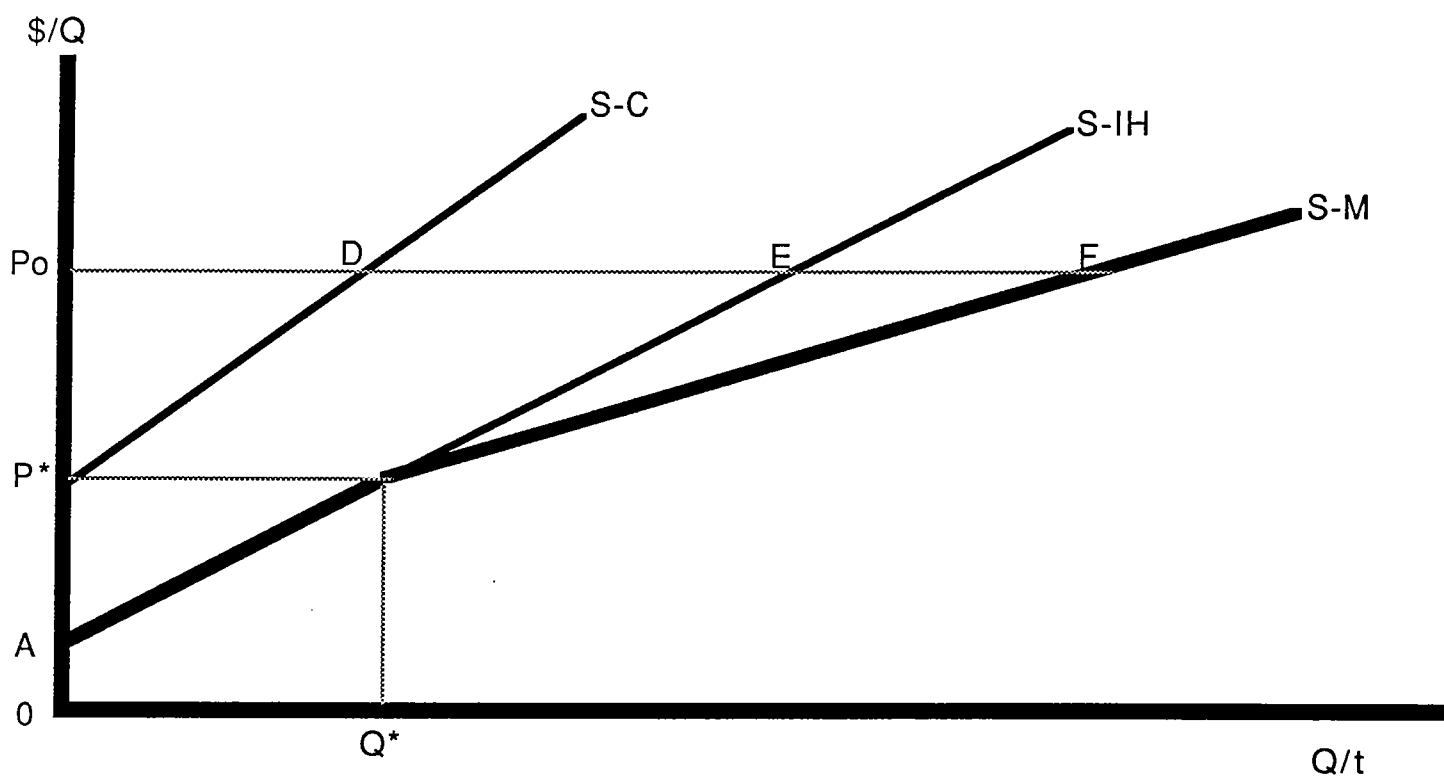


Figure G-2. The market supply curve for sterilization (S-M) as the aggregate of the supply curves for contract sterilization (S-C) and in-house sterilization (S-IH).

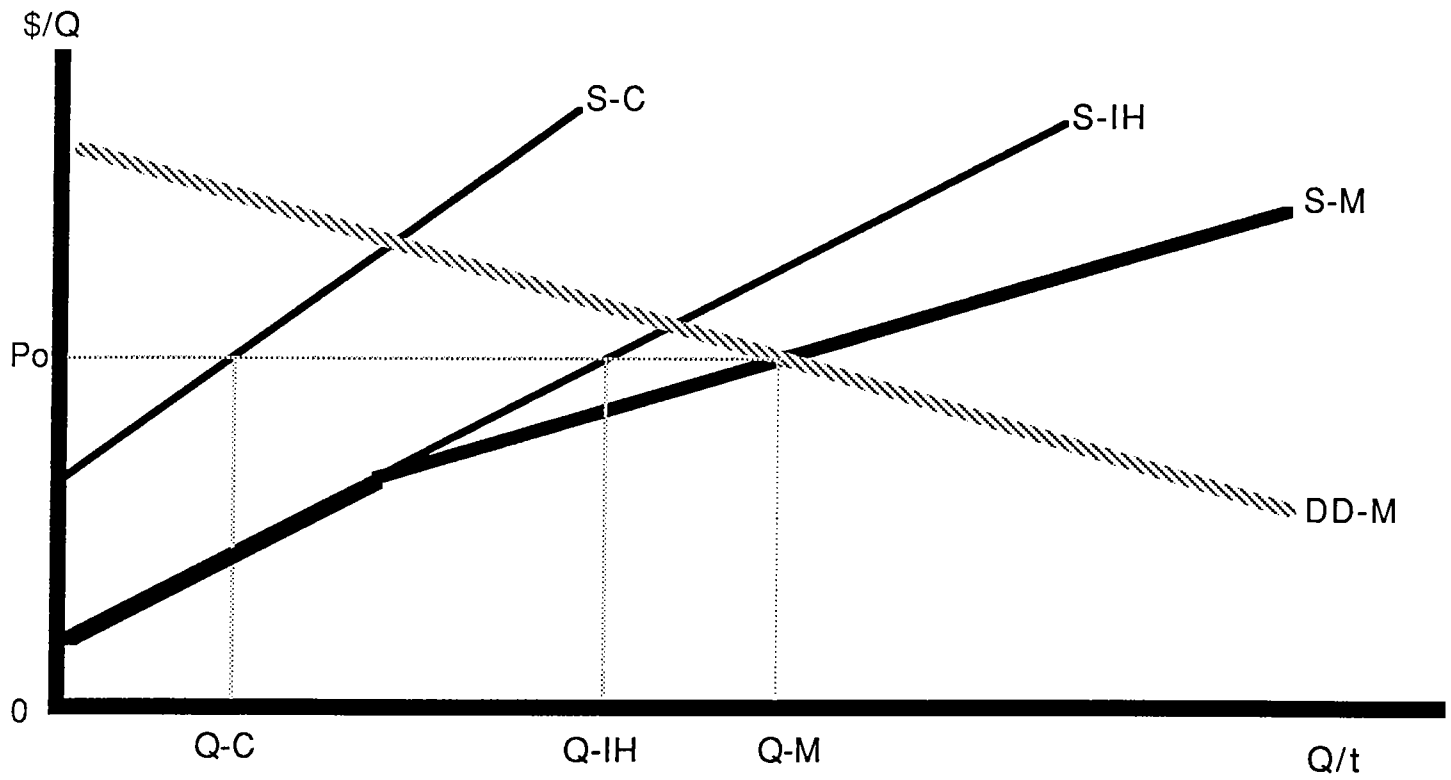


Figure G-3. Supply and demand curves for sterilization services, and the allocation of the equilibrium quantity of sterilization ($Q-M$) among contract sterilization ($Q-C$) and in-house sterilization ($Q-IH$).

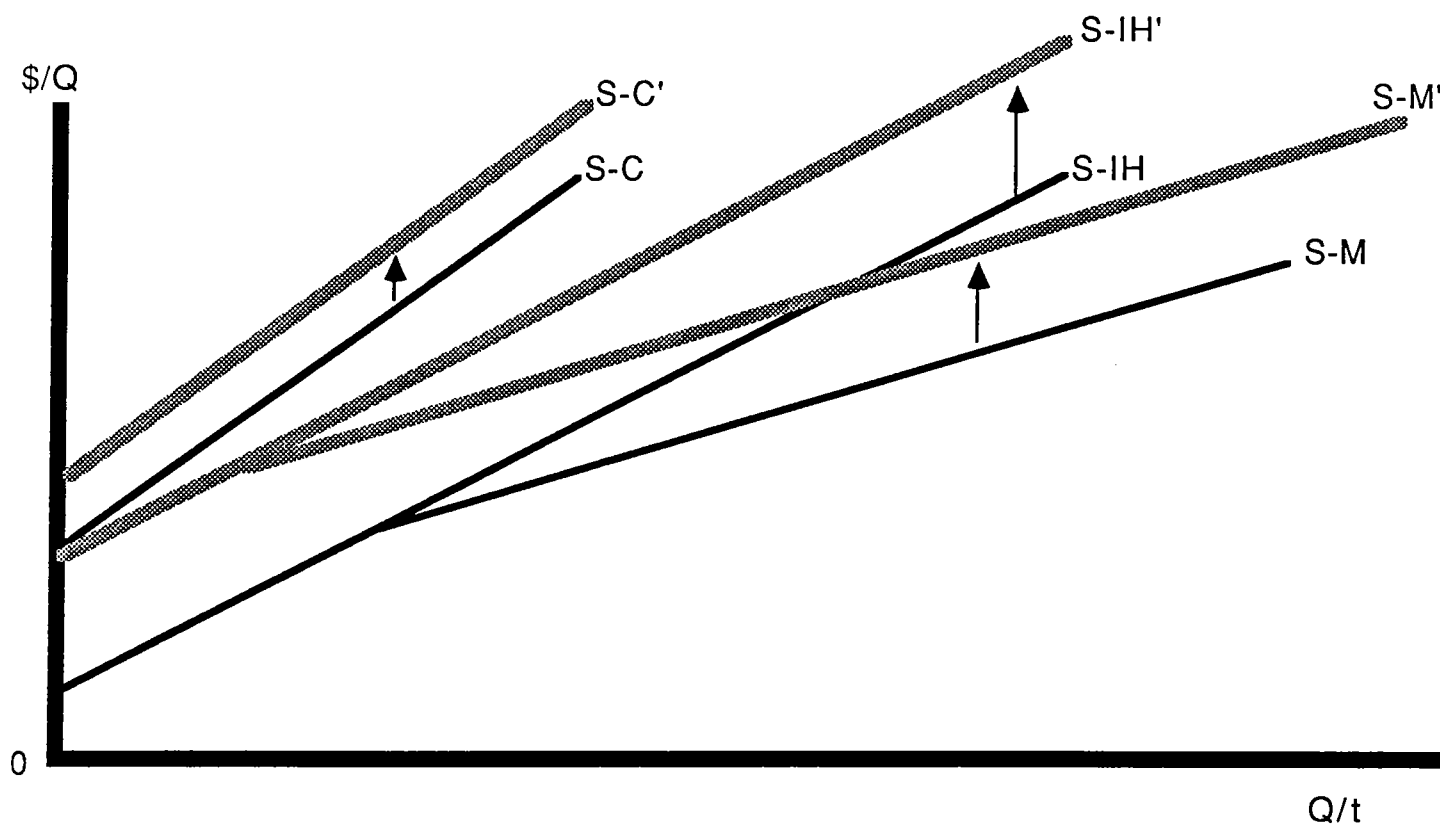


Figure G-4. Supply curves for sterilization services with and without ethylene oxide emissions controls.

scale in compliance. A smaller shift in S-C than S-IH is supported by the data in Tables 8-15 and 8-16, which show that contract sterilizers have the lowest mean TAC per kilogram of EO used, and lowest TAC per dollar of annual sterilization cost.

In Figure G-5 we superimpose the derived demand curve, DD-M, on the supply curves from Figure G-4. As before, the market equilibrium without the NESHAP controls occurs at price P_0 and quantity $Q-M$; in-house sterilizers sterilize quantity $Q-IH$ and contract sterilizers sterilize quantity $Q-C$. The adoption of the NESHAP controls causes the supply curves to shift upward to $S-C'$, $S-IH'$ and $S-M'$. The new market equilibrium occurs at a higher price, P' , and a lower quantity, $Q-M'$. At the new price, in-house sterilizers sterilize a lower quantity, $Q-IH'$, and contract sterilizers sterilize a higher quantity, $Q-C'$.

The absolute increase in contract sterilizers' quantity may or may not occur, depending on the actual positions and shapes of the supply and demand curves in Figure G-5. However, the contract sterilizers' share of total market quantity will definitely increase, due to their lower average TAC per unit of goods sterilized. The market price of sterilization will rise, unless DD-M is horizontal (i.e., perfectly elastic). The market quantity of sterilization will decrease unless the DD-M curve is vertical (i.e., perfectly inelastic). And finally, the quantity of in-house sterilization will decrease.

In summary, the adoption of the candidate NESHAP controls should cause some substitution of contract sterilization for in-house sterilization. So even though the candidate controls will increase the cost of sterilization for contract sterilizers, their market share of total sterilization will increase. Additionally, their total quantity may actually increase, rather than decrease, under certain circumstances regarding the demand and supply relationships in the sterilization market.

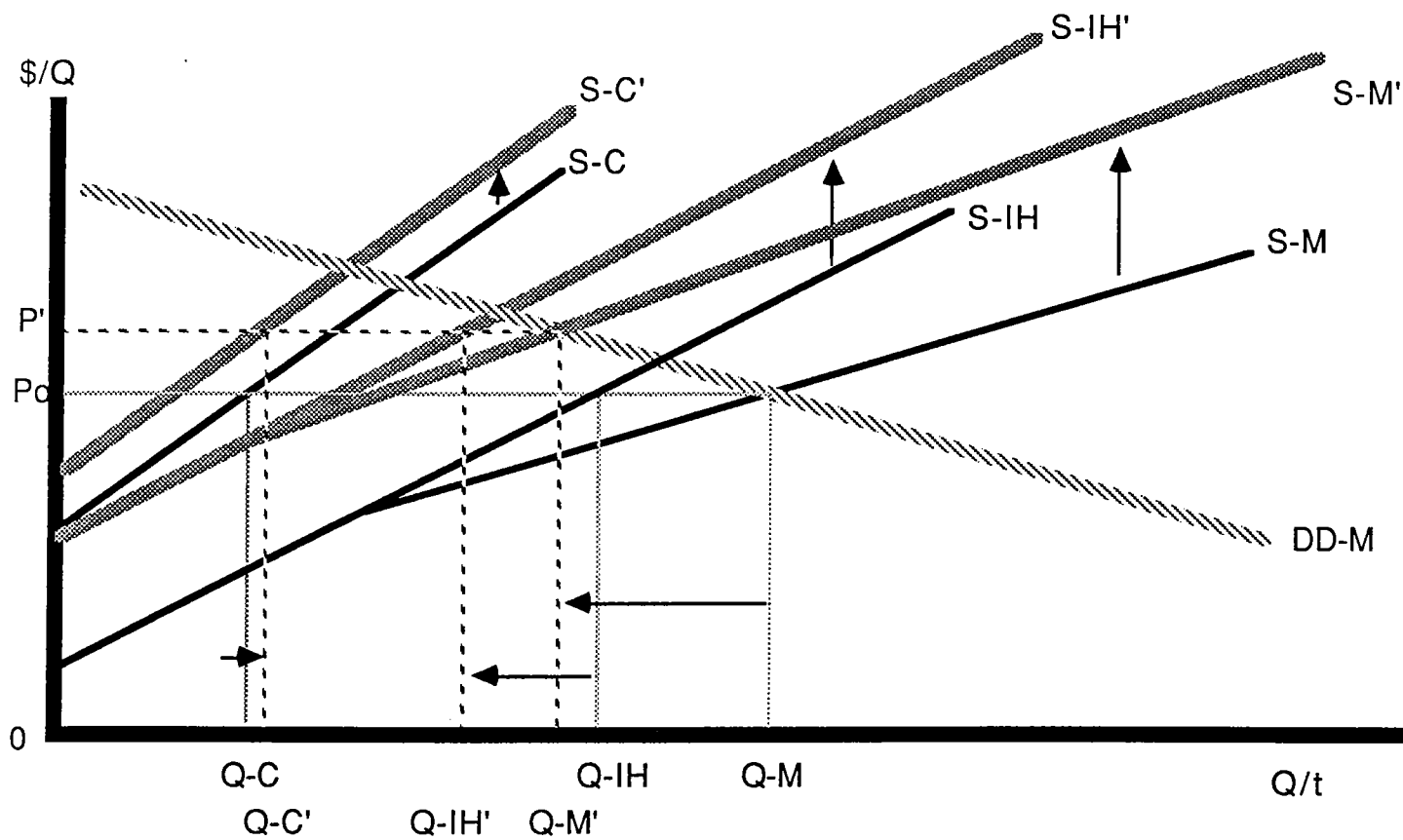


Figure G-5. Market equilibrium and allocation of sterilization services with and without ethylene oxide emission controls.

SUPPLEMENT TO THE COMMERCIAL STERILIZATION BACKGROUND
INFORMATION DOCUMENT--ENVIRONMENTAL AND COST IMPACTS
ASSOCIATED WITH REGULATORY COMPLIANCE

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1.0 INTRODUCTION

This document presents the estimated environmental and cost impacts associated with reducing ethylene oxide (EO) emissions from commercial sterilization facilities. Because only one control device and associated removal efficiency was considered, impacts associated with regulating commercial sterilizers were evaluated for cutoff levels designed to exclude segments of the industry from regulation. Eighty-two cutoff levels based on a facility's total chamber volume and EO use rate were developed to evaluate the environmental and cost impacts. Any facility with a total chamber volume or EO use rate greater than or equal to the chamber volume or EO use rate for a particular cutoff level would be subject to regulation. Facilities below the cutoff level would not be subject to regulation and could continue to operate using current practices.

The methodologies for assessing the environmental and cost impacts for each cutoff level are discussed in Chapters 6 and 7 of the BID, respectively. The information presented in this supplement will be used to select a cutoff level (regulatory option) that will serve as the basis for the commercial sterilization standard.

2.0 SELECTION OF A REGULATORY OPTION

In response to the vinyl chloride court decision, the Agency is anticipated to use a two-step approach for selecting a regulatory option to serve as the basis for the commercial sterilization regulation. The first step involves determining the level that is protective of health that represents an acceptable risk. The second step involves a determination of the level that provides an ample margin of safety to protect public health.

3.0 BACKGROUND

This section provides a description of the source category as well as a discussion of emission sources and applicable control techniques.

3.1 SOURCE CATEGORY DESCRIPTION

This source category includes the use of EO as a sterilant in the production of medical equipment supplies and in miscellaneous sterilization and fumigation operations. Sterilization operations at hospitals, which are considered as a separate source category, are not

included. Available information indicates that EO is used at over 200 commercial sterilization facilities in the U.S. These facilities use EO to sterilize or fumigate a variety of materials, including medical equipment (e.g., syringes and surgical gloves), spices, cosmetics, pharmaceuticals, and bee hives. Additionally, EO is used by libraries and museums to fumigate books and other historical items. While most sterilization processes are performed at the facility producing the sterile product, some facilities send their products to contract sterilizers (i.e., firms under contract to sterilize products manufactured by other companies).

The information available to EPA for the commercial sterilization source category was obtained from the following two sources: (1) a survey of medical equipment suppliers conducted by the Health Industry Manufacturer's Association (HIMA) in 1985 and (2) information requests submitted by EPA under Section 114 of the Clean Air Act to miscellaneous sterilizers and fumigators in 1986.^{1,2} The miscellaneous sterilization and fumigation facilities were identified during an extensive survey of potential EO users. The facilities that comprise the EPA commercial sterilization data base are located in 43 States and Puerto Rico. These facilities were grouped by Standard Industrial Classification (SIC) codes into the following categories:

1. medical equipment suppliers;
2. pharmaceutical manufacturers;
3. other health-related industries;
4. spice manufacturers;
5. contract sterilizers;
6. libraries, museums, and archives;
7. laboratories (research, testing, and animal breeding); and
8. State departments of agriculture.

Commercial sterilization using EO is typically conducted in sealed chambers ranging in volume from 2.8 cubic meters (m^3) (100 cubic feet [ft^3]) to 28 m^3 (1,000 ft^3). Although pure EO or mixtures of EO and carbon dioxide (CO_2) are sometimes used, a mixture of 12 percent by weight EO and 88 percent by weight dichlorodifluoromethane (CFC-12) is more common. This mixture, referred to as "12/88," is nonexplosive and

nonflammable. Therefore, its use does not require explosion-proof chambers and other safety precautions that are necessary when pure EO is used. Because EO/CO₂ mixtures require higher pressures to achieve the necessary EO concentration, some sensitive items cannot be sterilized by EO/CO₂ sterilant gas mixtures.

Medical equipment, spices, cosmetics, and pharmaceuticals are generally sterilized by achieving a concentration of about 600 milligrams of EO per liter (mg/l) inside the chamber. At the start of the sterilization process, products are loaded into the chamber, and the door is sealed. The chamber pressure is reduced to a pressure of about 6.9 to 69 kilopascals (kPa) (1 to 10 pounds per square inch absolute [psia]) for 12/88 and 3 kPa (0.4 psia) for pure EO. The initial drawdown takes from about 5 to 45 minutes, depending on the product being sterilized. Certain products require a longer drawdown time because they are damaged by sudden pressure changes. Adjustments are also made to the chamber temperature and relative humidity to ensure efficient sterilization. Once these conditions are achieved, the sterilant gas is pumped into the chamber to achieve the desired EO concentration, and the chamber is then maintained under these conditions for typically 4 to 6 hours.

The EO penetrates all product packaging (e.g., the cardboard shipping box, plastic shrink wrap, paper box, and final product wrapping) and destroys bacteria on contact. Products remain sterile until use because bacteria cannot penetrate the product wrapping. Books and historical items are fumigated in a similar manner to prevent deterioration caused by mildew. Bee hives are fumigated in mobile sterilization chambers operated by several State Departments of Agriculture.

When sterilization is completed, the chamber is evacuated by a vacuum pump and then brought up to atmospheric pressure by introducing clean, filtered air (or nitrogen or CO₂ when a flammable sterilant gas is used). The evacuation and pressurization steps (i.e., air washes) may be repeated from two to four times to remove as much EO from the products as possible. Finally, at most facilities, the chamber doors are opened, and the products are taken to an aeration room where residual EO is allowed to diffuse out of the product prior to shipping. Alternatively, a few commercial sterilizers allow their products to aerate in the chamber.

3.2 DESCRIPTION OF EMISSION SOURCES AND CONTROL TECHNIQUES

There are three major sources of emissions at commercial sterilization facilities: the sterilization chamber vent, the vacuum pump drain, and the aeration room. Based on conversations with industry representatives and limited test data from one facility, it is estimated that at most facilities the vent, drain, and aeration room account for approximately 50, 45, and 5 percent of total emissions, respectively.^{3,4} Other potential emission sources such as equipment leaks and materials handling are assumed to be insignificant.

Emissions from vents and drains are associated with the chamber vacuum pump. These vacuum pumps are typically "once-through, liquid-ring" designs that use water as the working fluid. A mixture of water and chamber gas is expelled from the pump to a centrifugal liquid-gas separator, where gases are ducted to a vent and liquids are discharged to a sewer drain. As the liquids pass down the drain, EO desorbs and escapes to the atmosphere.

Emission control at commercial sterilization facilities may be achieved by: (1) replacing the once-through water-sealed vacuum pump with a closed-loop recirculating-fluid pump, thus eliminating EO emissions from the pump drain water; and (2) installing an acid/water scrubber to control emissions from the vacuum pump vent and emissions from the drain that are routed to the vent. Facilities with existing oxidation control devices (e.g., flares, catalytic oxidation units) could achieve regulatory compliance by implementing a recirculating vacuum pump system to route all chamber vent and drain emissions to the existing control device, provided the device is operating at the maximum achievable efficiency (e.g., 98 percent for flares, approximately 98 percent for catalytic oxidizers).

Aeration room emissions occur as EO diffuses out of sterilized products. Aeration room emissions are assumed to be uncontrolled at baseline and in the regulatory analyses.

4.0 INFORMATION FOR SELECTING REGULATORY OPTIONS (CUTOFF LEVELS)

A discussion of the 82 cutoff levels is presented in Section 5.2 of the BID. The methodologies for estimating the environmental and cost impacts are discussed in Chapters 6 and 7 of the BID, respectively. The environmental and health impacts associated with each of the 82 cutoff

levels are summarized in Table 1a. Table 1b presents environmental, health, and cost impacts for each of the cutoff levels. From the cutoff levels, seven preliminary regulatory options have been selected. A summary of the environmental and health impacts associated with these seven preliminary options is presented in Table 2a. Table 2b presents environmental, health, and cost impacts for the preliminary regulatory options. Option No. 1 represents the regulation of all facilities. Option No. 26 was selected as a reference (or starting point) option because it is a reasonably stringent cutoff level that provides for the regulation of all facilities with a maximum individual risk (MIR) greater than 10^{-3} . Option Nos. 41 and 48 represent an increase of 1 and 2 percent (of the baseline value), respectively, in the number of people at a risk level of 10^{-4} or greater, compared to the reference option (No. 26). Option No. 43 represents 95 percent reduction of the potentially reducible incidence (i.e., the incidence attributed to 99 percent of vent and drain emissions; incidence attributed to aeration rooms is not included). Option No. 77 is the least stringent cutoff level with no people at a risk level of 10^{-3} or greater. Option No. 82 represents the baseline level of control.

5.0 SHORT-TERM DISPERSION MODELING

This section provides a discussion of the short-term dispersion modeling methodology as well as the input parameters and modeling results.

5.1 INTRODUCTION

In 1985 EPA published a Federal Register notice titled "Assessment of Ethylene Oxide as a Potentially Hazardous Air Pollutant."⁵ The conclusion of that notice, based on the information available, was that EPA intended to list EO under Section 112 of the Clean Air Act (CAA) if emission standards were warranted. This notice also asked for comments on the information and conclusions it presented and solicited additional information.⁶

Although the focus of the notice was the risk of cancer, it included a section on the potential for noncancer health effects associated with EO exposure. Since publication of the Federal Register, EPA has initiated an additional analysis of the potential for noncancer health endpoints. Specifically, the analysis is focusing on reproductive effects in females

TABLE 1a. SUMMARY OF ENVIRONMENTAL/HEALTH IMPACTS ASSOCIATED WITH THE 82 REGULATORY OPTIONS
(TOTAL CHAMBER SIZE AND EO USE CUTOFF LEVELS)

REGULATORY OPTION NO.	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	EMISSION REDUCTION (lb/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	IG SOLUTION FROM ACID/WATER SCOURERS (lb/yr)	NUMBER CUTOFF BELOW CUTOFF WITH MIR >10(-3)	NUMBER CUTOFF BELOW CUTOFF WITH MIR >10(-4)	NUMBER CUTOFF BELOW CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT
1	0	0	1753.072	100.00	2.8603	100.00	9443117	0	0	0	0.00000000	191
2	100	5000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
3	100	10000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
4	100	15000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
5	100	20000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
6	100	25000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
7	100	30000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
8	100	35000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
9	100	40000	1747.515	99.68	2.8510	99.67	9413175	0	2	10	0.00014100	152
10	200	5000	1741.433	99.34	2.8369	99.18	9360381	0	3	19	0.00029700	138
11	200	10000	1739.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
12	200	15000	1738.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
13	200	20000	1738.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
14	200	25000	1738.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
15	200	30000	1738.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
16	200	35000	1738.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
17	200	40000	1738.190	99.21	2.8292	98.91	9368288	0	3	19	0.00029700	138
18	300	5000	1734.156	98.92	2.8184	98.54	9341149	0	6	29	0.00029700	125
19	300	10000	1724.201	98.35	2.7947	97.71	9287480	0	9	32	0.00040000	121
20	300	15000	1719.674	98.09	2.7924	97.63	9263071	0	10	33	0.00064400	120
21	300	20000	1719.674	98.09	2.7924	97.63	9263071	0	10	33	0.00064400	120
22	300	25000	1719.674	98.09	2.7924	97.63	9263071	0	10	33	0.00064400	120
23	300	30000	1719.674	98.09	2.7924	97.63	9263071	0	10	33	0.00064400	120
24	300	35000	1719.674	98.09	2.7924	97.63	9263071	0	10	33	0.00064400	120
25	300	40000	1719.674	98.09	2.7924	97.63	9263071	0	10	33	0.00064400	120
26	400	5000	1732.251	98.81	2.8163	98.46	9330882	0	7	31	0.00029700	123
27	400	10000	1715.225	97.84	2.7807	97.22	9239089	0	12	36	0.00051600	117
28	400	15000	1708.568	97.46	2.7749	97.01	9203195	0	14	38	0.00064400	115
29	400	20000	1708.568	97.46	2.7749	97.01	9203195	0	14	38	0.00064400	115
30	400	25000	1708.568	97.46	2.7749	97.01	9203195	0	14	38	0.00064400	115
31	400	30000	1708.568	97.46	2.7749	97.01	9203195	0	14	38	0.00064400	115
		(1)	(2)	(3)	(4)	(5)	(8)	(9)	(10)	(11)	(12)	(13)

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TABLE 1a. (continued)

REGULATORY OPTION NO.	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	NO USE CUTOFF (lb/yr)	EMISSION REDUCTION (Mg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	KG SOLUTION FROM ACID/WATER SCRUBBERS (lb/yr)	NUMBER CUTOFF WITH MIR >10(-3)	NUMBER CUTOFF WITH MIR >10(-4)	NUMBER CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT
32	400	35000	1708.568	97.46	2.7749	97.01	9203195	0	14	38	0.00064400	115
33	400	40000	1708.568	97.46	2.7749	97.01	9203195	0	14	38	0.00064400	115
34	500	5000	1727.852	98.56	2.8116	98.30	9307177	0	9	35	0.00029700	117
35	500	10000	1706.207	97.33	2.7667	96.73	9190482	0	16	42	0.00051600	109
36	500	15000	1694.325	96.65	2.7560	96.35	9126415	0	19	45	0.00064400	106
37	500	20000	1694.325	96.65	2.7560	96.35	9126415	0	19	45	0.00064400	106
38	500	25000	1694.325	96.65	2.7560	96.35	9126415	0	19	45	0.00064400	106
39	500	30000	1694.325	96.65	2.7560	96.35	9126415	0	19	45	0.00064400	106
40	500	35000	1694.325	96.65	2.7560	96.35	9126415	0	19	45	0.00064400	106
41	500	40000	1694.325	96.65	2.7560	96.35	9126415	0	19	45	0.00064400	106
42	600	5000	1719.786	98.10	2.7914	97.59	9263682	0	13	42	0.00029700	110
43	600	10000	1690.199	96.41	2.7204	95.11	9104162	0	23	52	0.00051600	99
44	600	15000	1689.882	95.25	2.6970	94.29	8994624	0	28	57	0.00064400	94
45	600	20000	1661.738	94.79	2.6866	93.93	8950718	0	29	58	0.00064400	93
46	600	25000	1661.738	94.79	2.6866	93.93	8950718	0	29	58	0.00064400	93
47	600	30000	1661.738	94.79	2.6866	93.93	8950718	0	29	58	0.00064400	93
48	600	35000	1661.738	94.79	2.6866	93.93	8950718	0	29	58	0.00064400	93
49	600	40000	1661.738	94.79	2.6866	93.93	8950718	0	29	58	0.00064400	93
50	700	5000	1715.372	97.85	2.7640	97.33	9239907	0	14	46	0.00029700	105
51	700	10000	1676.490	95.63	2.6977	94.32	9030278	0	27	59	0.00051600	91
52	700	15000	1645.226	93.85	2.6539	92.78	8861718	0	34	66	0.00064400	84
53	700	20000	1630.427	93.00	2.6392	92.27	8781933	0	36	68	0.00080100	82
54	700	25000	1621.366	92.49	2.6347	92.11	8733082	1	37	69	0.00122000	81
55	700	30000	1621.366	92.49	2.6347	92.11	8733082	1	37	69	0.00122000	81
56	700	35000	1621.366	92.49	2.6347	92.11	8733082	1	37	69	0.00122000	81
57	700	40000	1621.366	92.49	2.6347	92.11	8733082	1	37	69	0.00122000	81
58	800	5000	1712.465	97.68	2.7729	96.84	9224235	0	15	48	0.00029700	103
59	800	10000	1673.583	95.47	2.6866	93.93	9014606	0	28	61	0.00051600	89
60	800	15000	1642.319	93.68	2.6428	92.40	8846046	0	35	68	0.00064400	82
61	800	20000	1627.520	92.84	2.6281	91.88	8766261	0	37	70	0.00080100	80
62	800	25000	1618.459	92.32	2.6236	91.72	8717410	1	38	71	0.00122000	79
(1) (2) (3) (4) (5) (8) (9) (10) (11) (12) (13)												

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TABLE 1a. (continued)

REGULATORY OPTION NO.	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	NO USE CUTOFF (lb/yr)	EMISSION REDUCTION (Mg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE FROM ACID/WATER REDUCTION SCORERS (lb/yr)	NUMBER CUTOFF WITH MIR >10(-3)	NUMBER CUTOFF WITH MIR >10(-4)	NUMBER CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT
63	800	30000	1618.459	92.32	2.6236	8117410	1	38	71	0.00122000	79
64	800	35000	1618.459	92.32	2.6236	8117410	1	38	71	0.00122000	79
65	800	40000	1618.459	92.32	2.6236	8117410	1	38	71	0.00122000	79
66	900	5000	1712.465	97.68	2.7729	9224235	0	15	48	0.00029700	103
67	900	10000	1670.448	95.29	2.6814	8997701	0	29	62	0.00051600	88
68	900	15000	1633.041	93.15	2.6317	8796022	0	36	70	0.00064400	80
69	900	20000	1610.449	91.86	2.6170	8674222	0	38	72	0.00080100	77
70	900	25000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
71	900	30000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
72	900	35000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
73	900	40000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
74	1000	5000	1712.465	97.68	2.7729	9224235	0	15	48	0.00029700	103
75	1000	10000	1670.448	95.29	2.6814	8997701	0	29	62	0.00051600	88
76	1000	15000	1633.041	93.15	2.6317	8796022	0	36	70	0.00064400	80
77	1000	20000	1610.449	91.86	2.6170	8674222	0	38	72	0.00080100	77
78	1000	25000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
79	1000	30000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
80	1000	35000	1601.388	91.35	2.6125	8625371	1	39	73	0.00122000	76
81	1000	40000	1586.440	90.49	2.5993	8544780	1	40	74	0.00122000	75
82	Baseline	0.000	0.000	0.00	0.0000	0	NA	NA	NA	NA	NA
							(9)	(10)	(11)	(12)	(13)

TABLE 1b. SUMMARY OF ENVIRONMENTAL, HEALTH, AND COST IMPACTS ASSOCIATED WITH THE 82 REGULATORY OPTIONS
(TOTAL CHAMBER SIZE AND EO USE CUTOFF LEVELS)

REGULATORY OPTION NO.	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	EMISSION REDUCTION (Mg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	TOTAL CAPITAL FROM ACID/WATER COSTS (millions)	EG SOLUTION FROM ACID/WATER SCORERS (lb/yr)	NUMBER BELOW CUTOFF WITH MIR >10(-3)	NUMBER BELOW CUTOFF WITH MIR >10(-4)	NUMBER BELOW CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT
1	0	0	1753.072	100.00	2.8603	100.00	6.62	23.15	9443117	0	0	0	0.00000000	191
2	100	5000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
3	100	10000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
4	100	15000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
5	100	20000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
6	100	25000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
7	100	30000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
8	100	35000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
9	100	40000	1747.515	99.68	2.8510	99.67	5.70	19.75	9413175	0	2	10	0.00014100	152
10	200	5000	1741.433	99.34	2.8369	99.18	5.39	18.59	9380381	0	2	10	0.00014100	152
11	200	10000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
12	200	15000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
13	200	20000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
14	200	25000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
15	200	30000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
16	200	35000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
17	200	40000	1739.190	99.21	2.8292	98.91	5.37	18.51	9368288	0	3	19	0.00029700	138
18	300	5000	1734.156	98.92	2.8184	98.54	5.07	17.45	9341149	0	6	29	0.00029700	125
19	300	10000	1724.201	98.35	2.7947	97.71	4.98	17.13	9287480	0	9	32	0.00040000	121
20	300	15000	1719.674	98.09	2.7924	97.63	4.95	17.05	9263071	0	10	33	0.00064400	120
21	300	20000	1719.674	98.09	2.7924	97.63	4.95	17.05	9263071	0	10	33	0.00064400	120
22	300	25000	1719.674	98.09	2.7924	97.63	4.95	17.05	9263071	0	10	33	0.00064400	120
23	300	30000	1719.674	98.09	2.7924	97.63	4.95	17.05	9263071	0	10	33	0.00064400	120
24	300	35000	1719.674	98.09	2.7924	97.63	4.95	17.05	9263071	0	10	33	0.00064400	120
25	300	40000	1719.674	98.09	2.7924	97.63	4.95	17.05	9263071	0	10	33	0.00064400	120
26	400	5000	1732.251	98.81	2.8163	98.46	5.03	17.29	9330882	0	7	31	0.00029700	123
27	400	10000	1715.225	97.84	2.7807	97.22	4.88	16.81	9239089	0	12	36	0.00051600	117
28	400	15000	1708.568	97.46	2.7749	97.01	4.85	16.71	9203195	0	14	38	0.00064400	115
29	400	20000	1708.568	97.46	2.7749	97.01	4.85	16.71	9203195	0	14	38	0.00064400	115
30	400	25000	1708.568	97.46	2.7749	97.01	4.85	16.71	9203195	0	14	38	0.00064400	115
31	400	30000	1708.568	97.46	2.7749	97.01	4.85	16.71	9203195	0	14	38	0.00064400	115
										(9)	(10)	(11)	(12)	(13)
										(8)				
										(7)				
										(6)				
										(5)				
										(4)				
										(3)				
										(2)				
										(1)				

TABLE 1b. (continued)

REGULATORY OPTION NO.	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	EMISSION REDUCTION (Mg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	TOTAL CAPITAL COSTS (millions)	EG SOLUTION FROM ACID/WATER SCRUBBERS (lb/yr)	NUMBER BELOW CUTOFF WITH MIR >10(-3)	NUMBER BELOW CUTOFF WITH MIR >10(-4)	NUMBER BELOW CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT
32	400	35000	1708.568	97.46	2.7749	97.01	4.85	16.71	9203195	0	14	38	0.00064400	115
33	400	40000	1708.568	97.46	2.7749	97.01	4.85	16.71	9203195	0	14	38	0.00064400	115
34	500	5000	1727.852	98.56	2.8116	98.30	4.87	16.67	9307177	0	9	35	0.00029700	117
35	500	10000	1706.207	97.33	2.7667	96.73	4.66	16.01	9190482	0	16	42	0.00051600	109
36	500	15000	1694.325	96.65	2.7560	96.35	4.60	15.83	9126415	0	19	45	0.00051600	106
37	500	20000	1694.325	96.65	2.7560	96.35	4.60	15.83	9126415	0	19	45	0.00051600	106
38	500	25000	1694.325	96.65	2.7560	96.35	4.60	15.83	9126415	0	19	45	0.00051600	106
39	500	30000	1694.325	96.65	2.7560	96.35	4.60	15.83	9126415	0	19	45	0.00051600	106
40	500	35000	1694.325	96.65	2.7560	96.35	4.60	15.83	9126415	0	19	45	0.00051600	106
41	500	40000	1694.325	96.65	2.7560	96.35	4.60	15.83	9126415	0	19	45	0.00051600	106
42	600	5000	1719.786	98.10	2.7914	97.59	4.65	15.86	9265682	0	13	42	0.00029700	110
43	600	10000	1690.199	96.41	2.7204	95.11	4.37	14.90	9104162	0	23	52	0.00051600	99
44	600	15000	1669.882	95.25	2.6970	94.29	4.27	14.60	8994624	0	28	57	0.00064400	94
45	600	20000	1661.738	94.79	2.6866	93.93	4.24	14.47	8950718	0	29	58	0.00064400	93
46	600	25000	1661.738	94.79	2.6866	93.93	4.24	14.47	8950718	0	29	58	0.00064400	93
47	600	30000	1661.738	94.79	2.6866	93.93	4.24	14.47	8950718	0	29	58	0.00064400	93
48	600	35000	1661.738	94.79	2.6866	93.93	4.24	14.47	8950718	0	29	58	0.00064400	93
49	600	40000	1661.738	94.79	2.6866	93.93	4.24	14.47	8950718	0	29	58	0.00064400	93
50	700	5000	1715.372	97.85	2.7840	97.33	4.55	15.43	9239907	0	14	46	0.00029700	105
51	700	10000	1676.490	95.63	2.6977	94.32	4.17	14.16	9030278	0	27	59	0.00051600	91
52	700	15000	1645.226	93.85	2.6539	92.78	4.01	13.61	8861718	0	34	66	0.00064400	84
53	700	20000	1630.427	93.00	2.6392	92.27	3.93	13.33	8781933	0	36	68	0.00080100	82
54	700	25000	1621.366	92.49	2.6347	92.11	3.89	13.19	8733082	1	37	69	0.00122000	81
55	700	30000	1621.366	92.49	2.6347	92.11	3.89	13.19	8733082	1	37	69	0.00122000	81
56	700	35000	1621.366	92.49	2.6347	92.11	3.89	13.19	8733082	1	37	69	0.00122000	81
57	700	40000	1621.366	92.49	2.6347	92.11	3.89	13.19	8733082	1	37	69	0.00122000	81
58	800	5000	1712.465	97.68	2.7729	96.94	4.47	15.14	9224235	0	15	48	0.00029700	103
59	800	10000	1673.583	95.47	2.6866	93.93	4.10	13.87	9014606	0	28	61	0.00051600	89
60	800	15000	1642.319	93.68	2.6428	92.40	3.93	13.32	8846046	0	35	68	0.00064400	82
61	800	20000	1627.520	92.84	2.6281	91.88	3.85	13.04	8766261	0	37	70	0.00080100	80
62	800	25000	1618.459	92.32	2.6236	91.72	3.81	12.89	8717410	1	38	71	0.00122000	79

TABLE 1b. (continued)

REGULATORY OPTION NO.	TOTAL CHAMBER SIZE CUTOFF (cubic feet)	EO USE CUTOFF (lb/yr)	EMISSION REDUCTION (Mg/yr)	EMISSION REDUCTION (% of total)	INCIDENCE REDUCTION (cases/yr)	INCIDENCE REDUCTION (% of total)	ANNUALIZED COSTS (millions)	TOTAL CAPITAL FROM ACID/WATER COSTS (millions)	EG SOLUTION SCRUBBERS (lb/yr)	NUMBER BELOW CUTOFF WITH MIR >10(-3)	NUMBER BELOW CUTOFF WITH MIR >10(-4)	NUMBER BELOW CUTOFF WITH MIR >10(-5)	HIGHEST MIR BELOW CUTOFF	NUMBER OF FACILITIES ABOVE CUT
63	800	30000	1618.459	92.32	2.6236	91.72	3.81	12.89	8717410	1	38	71	0.00122000	79
64	800	35000	1618.459	92.32	2.6236	91.72	3.81	12.89	8717410	1	38	71	0.00122000	79
65	800	40000	1618.459	92.32	2.6236	91.72	3.81	12.89	8717410	1	38	71	0.00122000	79
66	900	5000	1712.465	97.68	2.7729	96.94	4.47	15.14	9224235	0	15	48	0.00029700	103
67	900	10000	1670.448	95.29	2.6814	93.75	4.06	13.71	8997701	0	29	62	0.00051600	88
68	900	15000	1633.041	93.15	2.6317	92.01	3.86	13.08	8796022	0	36	70	0.00064400	80
69	900	20000	1610.449	91.86	2.6170	91.49	3.75	12.66	8674222	0	38	72	0.00060100	77
70	900	25000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
71	900	30000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
72	900	35000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
73	900	40000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
74	1000	5000	1712.465	97.68	2.7729	96.94	4.47	15.14	9224235	0	15	48	0.00029700	103
75	1000	10000	1670.448	95.29	2.6814	93.75	4.06	13.71	8997701	0	29	62	0.00051600	88
76	1000	15000	1633.041	93.15	2.6317	92.01	3.86	13.08	8796022	0	36	70	0.00064400	80
77	1000	20000	1610.449	91.86	2.6170	91.49	3.75	12.66	8674222	0	38	72	0.00060100	77
78	1000	25000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
79	1000	30000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
80	1000	35000	1601.388	91.35	2.6125	91.34	3.71	12.52	8625371	1	39	73	0.00122000	76
81	1000	40000	1586.440	90.49	2.5993	90.88	3.66	12.36	8544780	1	40	74	0.00122000	75
82	Baseline		0.000	0.00	0.0000	0.00	0.00	0.00	0	NA	NA	NA	NA	NA

(1)

(2)

(3)

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(11)

(12)

(13)

TABLE 2a. PRELIMINARY REGULATORY OPTIONS

Option No. (cutoff level)	Description of selected option	Total chamber size cutoff, ft ³	ED use cutoff, lb/yr	Incidence reduction, cases/yr	Incidence reduction, % of total ^a	Highest MIR below cutoff ^b	People at a risk level of			No. of facilities above cutoff
							$\geq 10^{-4}$, thousands	$\geq 10^{-5}$, thousands	$\geq 10^{-6}$, thousands	
1	All facilities controlled	0	0	2.86	100.00	0.00000	1.7	87	1,700	191
26	Reference option	400	5,000	2.82	98.46	0.00030	2.0	99	1,900	123
41	1 percent increase in people at a risk level of $\geq 10^{-4}$ compared to reference option ^c d	500	40,000	2.76	96.35	0.00064	3.2	120	2,300	106
43	Option achieves 95 percent incidence reduction	600	10,000	2.72	95.11	0.00052	3.6	130	2,600	99
48	2 percent increase in people at a risk level of $\geq 10^{-4}$ compared to reference option ^d e	600	35,000	2.69	93.93	0.00064	4.3	140	2,900	93
77	Least stringent option with zero people at a risk level of $\geq 10^{-3}$	1,000	20,000	2.62	91.49	0.00080	5.8	190	3,400	77
82	Baseline	--	--	0.00	0.00	0.010	120	2,300	35,000	0

^aThe percent incidence reduction represents the percentage of potentially controllable emissions (i.e., 99 percent of vent and drain emissions, based on acid/water scrubber technology) that are reduced. Incidence attributed to aeration rooms is not included.

^bThe highest maximum individual risk (MIR) associated with a facility below the cutoff.

^cThe number of additional people exposed to a risk level of $\geq 10^{-4}$ for this option, as compared to the reference option, is equivalent to about 1 percent of the total people exposed at baseline to a risk level of $\geq 10^{-4}$.

^dThe most stringent option with equivalent regulatory impacts was chosen.

^eThe number of additional people exposed to a risk level of $\geq 10^{-4}$ for this option, as compared to the reference option, is equivalent to about 2 percent of the total people exposed at baseline to a risk level of $\geq 10^{-4}$.

TABLE 2b. PRELIMINARY REGULATORY OPTIONS

Option No. (cutoff level)	Description of selected option	Total chamber size cutoff, ft ³	EO use cutoff, lb/yr	Incidence reduction, cases/yr	Incidence reduction, % of total ^a	Annualized costs, million \$	Highest MIR below cutoff ^b	People at a risk level of			No. of facilities above cutoff
								$\geq 10^{-4}$, thousands	$\geq 10^{-5}$, thousands	$\geq 10^{-6}$, thousands	
1	All facilities controlled	0	0	2.86	100.00	6.62	0.00000	1.7	87	1,700	191
26	Reference option	400	5,000	2.82	98.46	5.03	0.00030	2.0	99	1,900	123
41	1 percent increase in people at a risk level of $\geq 10^{-4}$ compared to reference option ^c d	500	40,000	2.76	96.35	4.60	0.00064	3.2	120	2,300	106
43	Option achieves 95 percent incidence reduction	600	10,000	2.72	95.11	4.37	0.00052	3.6	130	2,600	99
48	2 percent increase in people at a risk level of $\geq 10^{-4}$ compared to reference option ^d e	600	35,000	2.69	93.93	4.20	0.00064	4.3	140	2,900	93
77	Least stringent option with zero people at a risk level of $\geq 10^{-3}$	1,000	20,000	2.62	91.49	3.75	0.00080	5.8	190	3,400	77
82	Baseline	--	--	0.00	0.00	0.00	0.010	120	2,300	35,000	0

^aThe percent incidence reduction represents the percentage of potentially controllable emissions (i.e., 99 percent of vent and drain emissions, based on acid/water scrubber technology) that are reduced. Incidence attributed to aeration rooms is not included.

^bThe highest maximum individual risk (MIR) associated with a facility below the cutoff.

^cThe number of additional people exposed to a risk level of $\geq 10^{-4}$ for this option, as compared to the reference option, is equivalent to about 1 percent of the total people exposed at baseline to a risk level of $\geq 10^{-4}$.

^dThe most stringent option with equivalent regulatory impacts was chosen.

^eThe number of additional people exposed to a risk level of $\geq 10^{-4}$ for this option, as compared to the reference option, is equivalent to about 2 percent of the total people exposed at baseline to a risk level of $\geq 10^{-4}$.

associated with EO exposure. The purpose of this discussion is to document the methodology that is being employed in this exposure and risk analysis.⁶

5.2 HEALTH EFFECTS

The Health Assessment Document for Ethylene Oxide (HAD) summarizes data pertinent to noncancer health effects as well as cancer.⁷ A draft of this document was reviewed publicly and by the Science Advisory Board (SAB) on October 3, 1987. The studies by Snellings et al., 1982, were included in the draft reviewed by the SAB and were subsequently used as the basis for the lower-bound Health Reference Level (HRL) for reproductive effects calculated by the Reproductive Effects Assessment Group (REAG).⁸ The REAG reproductive risk assessment is based on the Guidelines for the Health Assessment of Suspect Developmental Toxicants and recent revisions to them.⁹ The derivation of the HRL has been patterned after the approach being developed for estimating levels (with uncertainty spanning perhaps an order of magnitude) of daily exposures to the human population (including sensitive subgroups) that is likely to be without appreciable risks of deleterious effects during a lifetime. Although this approach has been applied traditionally to effects data associated with chronic exposure, it has been used by REAG to develop levels associated with short-term exposures below which there is unlikely to be any associated health risk. The HRL is determined by applying an uncertainty factor and a modifying factor to the no observed adverse effect level (NOAEL) or lowest observed adverse effects level (LOAEL) from laboratory animals.⁶

Specific to EO, an uncertainty factor of 100 was applied to the 10 ppm lowest NOAEL from the Snellings study to calculate the lower bound HRL of 0.1 ppm. The REAG also calculated an upper bound HRL of 0.4 ppm based on a 1,200 ppm LOAEL with an uncertainty factor of 1,000 and a modifying factor of 3 applied. The latter is based on a 1987 study by Generosa et al. However, the Generosa study was not included in the HAD. In both the Snellings study and the Generosa study the effect observed was early embryonic death. Further details are available in the attached memorandum. The 0.1 ppm HRL is being used as the health benchmark for the purpose of this analysis.⁶

The current analysis has been limited to the potential for reproductive effects since information on additional health endpoints are still under development by the Office of Research and Development.

5.3 DESCRIPTION OF INDUSTRIAL SOURCE COMPLEX SHORT-TERM MODEL

The Industrial Source Complex Short-Term (ISCST) model is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial source complex. It can account for point, area, line, and volume sources; downwash; deposition of particles; and limited terrain adjustments. Average concentrations or total deposition may be calculated for 1-, 2-, 3-, 4-, 6-, 8-, and/or 24-hour time periods.

The source data required to run ISCST include source location, emission rate, physical stack height, exit velocity, inside stack diameter, and exit temperature. For area, line, and volume sources, the input data may vary slightly from point sources. Specifically, for an area source, the width of the emission area would be input in place of the stack diameter.

Meteorological data are also a part of the inputs to the model. The ISCST requires hourly surface weather data from the preprocessor program RAMMET. This includes hourly stability class, wind direction, wind speed, temperature, and mixing height. If site-specific data is not available, the hourly data can be read from formatted cards.

The concentrations can be estimated at various receptor locations chosen by the user. Either a rectangular or polar grid system can be selected. Discrete or arbitrarily placed receptor points also can be included. For terrain adjustments, the receptor ground elevation may be input as well.

For regulatory applications, the model contains a regulatory default option. This will automatically select certain options, such as stack tip downwash, final plume rise, buoyancy induced dispersion, and a building downwash algorithm. The Guideline on Air Quality Models (EPA-450/2-78-027R) provides a brief description of the model's applications and functions.

5.4 SHORT-TERM MODELING METHODOLOGY

5.4.1 Input Data for the Model

In the short-term modeling analysis of ethylene oxide emissions, concentrations were estimated for 15-minute and 8-hour averaging time periods. These averaging times were selected because of the wide exposure windows associated with the observed health effect. The ISCST model was applied with the regulatory default option and urban mode set. Input data was supplied for a model facility with six identical 1,000 ft³ sterilization chambers. These modeling inputs are presented in Attachments 1 and 2.

For the analysis of the six-chamber model sterilization facility, a rectangular receptor grid system was used. This included 392 receptor points on 6 rings concentric with the facility with the origin at the center of the plant. For the analysis of one unit, a polar receptor grid of 8 distances and 36 directions was used with the origin at the largest source.

As no specific location was given, a set of prototypical meteorological data were input. This set was read from formatted cards and included 104 days of possible wind speed, wind direction, and stability class combinations.

The releases occurred in an intermittent fashion as evidenced in the input data. This behavior was included in the estimation of the maximum concentrations. The ISCST provided 1-hour concentrations assuming the source emitted continuously over the 1-hour period. These estimates were adjusted to the 15-minute and 8-hour averaging times using a power law procedure based on release duration and stability class. The exponents used are based on Briggs (1973). A document prepared for the Source Receptor Analysis Branch (SRAB) under contract number 68-02-4351 provides more detail on the steps of this adjustment technique.

5.4.2 Resulting Ambient Concentrations

Using the modeling procedures discussed above, emissions from a prototypical 1,000 ft³ chamber were modeled to estimate ambient concentrations at various distances from the facility. These ambient concentrations are detailed in Attachment 3. In order to scale the estimated modeled concentrations to adjust for various chamber size ranges

above and below the prototypical 1,000 ft³ cumulative chamber size, a linear relationship was employed. Thus, modeled 15-minute and 8-hour ambient concentrations at various distances from the facility were estimated for all cumulative chamber size ranges.⁶

5.5 RESULTS

5.5.1 Exposure

The next step in this analysis is to estimate the number of people which could be exposed to these modeled concentrations. There is a great deal of uncertainty in trying to predict the numbers of people exposed to short-term concentration estimates because it is likely that these concentrations are confined to a limited area near the emission source for a very limited time. Furthermore, it is very difficult to predict where this area of elevated concentration will affect the population, if it does at all. Given these uncertainties, it is necessary to make some simplifying assumptions in order to estimate public exposure.⁶

By assuming a uniform population distribution around emission sources it is possible to develop a rough estimate of potential exposure. The Human Exposure Model (HEM) will be executed for each of the 197 commercial sterilization facilities using EO.¹⁰ This modeling analysis will yield rough estimates of the number of people residing within 3.5 kilometers (km) of each emission source. (The 3.5 km cutoff was chosen because within this distance the area of the polar grid cells created by the HEM roughly approximate the average area of a block group enumeration district from the U.S. census data and because the Agency's experience with estimating population density around point sources indicates that the variability in the estimate of population density tends to stabilize around 3.5 km.) The population estimate within 3.5 km will be used to estimate an average population density around each facility which will be used to estimate, based on area, the number of people within the distances associated with estimated concentrations of concern (i.e., concentrations greater than or equal to the HRL). The method for calculating the population at various radial distances within and beyond the 3.5 km radius employed by the HEM is illustrated in the following example. If 5,000 people were associated with the 3.5 km radius then the population within a 0.5 km radius is calculated as follows:⁶

Step 1: (population @ 3.5 km)/(area @ 3.5 km) = population density
(people/km²)

Step 2: (population density)x(area @ 0.5 km) = population at 0.5 km
or

Step 1: (5,000 people)/(3.1415 (3.5 km)²) = 130 people/km²

Step 2: (130 people/km²)x(3.1415 (0.5 km)²) = 102 people

This methodology will be employed to estimate the potentially exposed population with concentric rings at various distances from the EO emitting commercial sterilization facilities. Since the distance from each facility at which the HRL will be exceeded will vary with the cumulative chamber size (i.e., potential maximum emissions) it is expected that the potentially exposed population also will vary considerably with the chamber size. Once the potentially exposed population is estimated it will be adjusted to reflect the fact that the effect is observed only in women and particularly in women of child bearing age. It must be emphasized that this method of estimating population exposure only estimates the population residing near facilities; it does not represent the number of people actually exposed to the modeled concentrations. In fact, the number of people exposed to EO resulting from a single emission event would likely be much lower because a single emission event would result in a plume affecting a subset of the population within any given distance (dependent on the ambient meteorology and other factors). If the emission events were very frequent, as in the case of commercial sterilizers, the resulting plumes could affect a smaller, typically downwind population repeatedly, and, over time, possibly affect a significant proportion of the potentially exposed population. Similarly, in cases where most of the population residing near the emission point is confined to a localized area and the ambient conditions at the time of the release caused the plume to affect that area, the potentially exposed population may underestimate the potentially affected population. Finally, this methodology could underestimate exposure by considering only the population at a 3.5 km radius from the facility if major population centers exist just beyond that distance.⁶

In reviewing the exposure estimates generated through this methodology, it should be remembered that they serve only to gauge the

magnitude of the population potentially exposed at various levels and do not represent actual exposures to the concentrations modeled.⁶

5.5.2 Risk Assessment

The final step in this analysis will be to characterize the risk associated with exposure to the modeled short-term concentrations of EO.¹¹ As previously noted, the focus of this current analysis is a noncancer health endpoint, i.e., reproductive effects. Unlike the assessment of cancer risks which was the focus of the initial assessment of EO presented in the October 2, 1985, notice, this analysis is not quantitative in nature. The available data on the reproductive endpoint on which the HRL is based is not sufficient to adequately model the dose-response relationship and predict quantitative public health risk estimates. Due to these shortcomings in the available data, EPA has taken the approach of comparing the modeled concentrations of EO in the ambient air with concentrations known or estimated to cause this health effect in either humans or animals with uncertainty factors applied. It is not the intent of this analysis to attempt to prescribe an acceptable level of public exposure to EO. Rather, this analysis was designed to screen short-term modeled ambient concentrations against the available health effects data to determine if the potential for significant public health risk exists.⁶

For the purpose of this risk assessment, only the 15-minute concentrations are included. This is the more conservative of the two averaging times and is supported by the short exposure times during which the average reproductive effects could occur. The REAG concluded that a single 15-minute exposure could result in adverse reproductive effects in pregnant females if exposure occurred during early gestation.⁶

6.0 NOTES FOR TABLES 1a AND 1b

This section presents information to be used in interpreting Tables 1a and 1b.

1. A facility will be affected by the regulation if the total chamber size is greater than or equal to the chamber size cutoff or if the EO use rate is greater than or equal to the EO use cutoff. (See the columns labeled [1] on Tables 1a and 1b.)

2. Emission and incidence reduction (columns 2 and 4, respectively) were calculated assuming 99 percent control of chamber vent and vacuum pump drain emissions. Emissions and incidence attributed to aeration rooms, which are assumed to be uncontrolled, are not included. Residual emissions from aeration rooms are estimated to be 113 Mg/yr. The residual incidence attributed to aeration rooms is estimated to be 0.24 cases/yr.

3. The percent emission and incidence reduction values (columns 3 and 5, respectively) represent the percentage of potentially controllable emissions (i.e., 99 percent of vent and drain emissions, based on acid/water scrubber technology) that are reduced. Emissions and incidence attributed to aeration rooms are not included.

4. Column 8 presents the amount of ethylene glycol (EG) solution that would be generated above baseline as a result of acid/water scrubber control.

5. Columns 9, 10, and 11 indicate the number of facilities exempted from regulation that have MIR's greater than 10^{-3} , 10^{-4} , and 10^{-5} , respectively.

6. Column 12 shows the highest baseline MIR associated with a facility that is exempted from the regulation.

7.0 REFERENCES

1. Letter and enclosures from J. Jorkasky, Health Industry Manufacturers Association (HIMA), to D. Markwordt, EPA:CPB. February 21, 1986. Survey responses from HIMA members.
2. Responses to July 1986 Section 114 information request regarding the use of ethylene oxide by miscellaneous sterilization and fumigation facilities.
3. Abrams, W., McCormick and Company, Inc. Project No. 075320, Treatment of Spices-EtO Mass Balance. Final Report. November 26, 1985.
4. Telecon. Newton, D., MRI, with Popescu, M., Johnson and Johnson International. May 9, 1986. Discussion of EO emissions from sterilization process.
5. Federal Register (1985). Assessment of Ethylene Oxide as a Potentially Toxic Air Pollutant. 50 FR 40286, October 2, 1985.
6. Memorandum from Pate, N.B., ESD:PAB, to Project File. Ethylene Oxide Short-Term Exposure and Risk Assessment Methodology. March 31, 1988.

7. U. S. Environmental Protection Agency (1985). Health Assessment Document for Ethylene Oxide. Final Report, EPA/600/8-84/009F, Environmental Criteria and Assessment Office, Research Triangle Park, North Carolina. March 1987.
8. Kimmel, et al. (1988). (Reproductive Effects Assessment Group [RD-689], Office of Health and Environmental Assessment, U. S. Environmental Protection Agency, Washington, D.C.) Memorandum to I. Cote, PAB:OAQPS. Hazards for Developmental Toxicity From Acute Exposure to Ethylene Oxide. February 3, 1988.
9. Federal Register (1986). Guidelines for the Health Assessment of Suspected Developmental Toxicants. 51 FR 34028, September 24, 1986.
10. U. S. Environmental Protection Agency (1986). User's Manual for the Human Exposure Model (HEM). Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-450/5-86-001.
11. U. S. Environmental Protection Agency (1988). Ethylene Oxide Concentrations. Memorandum from A. Quillian to N. Pate, OAQPS. February 3, 1988.

April 7, 1988

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Dear Committee Member:

As indicated in my letter of March 17, the next meeting of the National Air Pollution Control Techniques Advisory Committee (NAPCTAC) is scheduled for May 18 and 19, 1988, at the Sheraton Imperial Hotel and Towers in Research Triangle Park, North Carolina.

Enclosed is the agenda for the meeting and a summary of the documents to be reviewed at the meeting. All of the documents to be discussed are also enclosed.

If you have not already done so, please make your reservations as soon as possible in order to take advantage of any discount fares available. A Government transportation request, which will be issued to you after you make your reservations, must be used to purchase your airline ticket.

Please call Mary Jane Clark at (919) 541-5571 if you need additional information or will be unable to attend.

Sincerely,

/s/

Jack R. Farmer
Chairperson
National Air Pollution Control
Techniques Advisory Committee

Enclosures

OAQPS: ESD: OD: MJClark; mjclark, rm 741, NCM, x5571 (MD-13): 4/7/88

bcc: Deb Micheltzsch, ESD/ISB (3 copies)
Dennis Crumpler, ESD/CPB (3 copies)
Ron Myers, ESD/ISB (3 copies)
Susan Thorneloe, ESD/CPB (3 copies)
K. C. Hustvedt, ESD/CPB (3 copies)
Mark Meech, ESD/CPB (3 copies)
Dave Markwordt, ESD/CPB (3 copies)
Bill Maxwell, ESD/ISB (3 copies)

Dianne Byrne, ESD/SDB
Sims Roy, ESD/SDB
Walt Stevenson, ESD/SDB
Dianne Byrne, ESD/SDB
Dianne Byrne, ESD/SDB
Doug Bell, ESD/SDB
Laura Butler, ESD/SDB
Rick Copland, ESD/SDB

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AGENDA

U. S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Sheraton Imperial Hotel and Towers
Empire Ballroom (A and B)
I-40 Exit 282 at Page Road
Research Triangle Park, North Carolina 27709

(919) 941-5050

MAY 18 AND 19, 1988

May 18 (Wednesday) - 9:00 a.m.

ASPHALT ROOFING

Review of Standards of Performance for New Stationary Sources
(Section 111 of the Clean Air Act)

VOLATILE ORGANIC COMPOUNDS (VOC's) CAPTURE EFFICIENCY

Test Methods and Procedures
(Sections 110 and 111 of the Clean Air Act)

MUNICIPAL WASTE COMBUSTION

Status Report to the Committee on Regulatory Development
(Sections 111 and 111(d) of the Clean Air Act)

MUNICIPAL SOLID WASTE LANDFILLS

Background Information and Regulatory Alternatives
(Sections 111 and 111(d) of the Clean Air Act)

TREATMENT, STORAGE, AND DISPOSAL FACILITIES (TSDF)

Background Information and Regulatory Alternatives
(Resource Conservation and Recovery Act)

PERCHLOROETHYLENE DRY CLEANING

Background Information and Regulatory Alternatives
(Section 112 of the Clean Air Act)

May 19 (Thursday) - 9:00 a.m.

CONTINUATION OF MAY 18--AS REQUIRED

ETHYLENE OXIDE COMMERCIAL STERILIZERS

Background Information and Regulatory Alternatives
(Section 112 of the Clean Air Act)

SMALL STEAM GENERATING UNITS

Status Report to the Committee on Regulatory Development
(Section 111 of the Clean Air Act)

Note: See reverse for current roster of the Committee.

4/5/88

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U.S. ENVIRONMENTAL PROTECTION AGENCY

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Chairperson and Executive Secretary

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 Director, Emission Standards Division (MD-13)
 Office of Air Quality Planning and Standards
 U. S. Environmental Protection Agency
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*New Committee Member

4

April 7, 1988

SUMMARY OF MATERIALS DISTRIBUTED FOR REVIEW AT THE MAY 18 AND 19, 1988,
MEETING OF THE NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Asphalt Roofing

Enclosed are a preliminary draft of the "Review of New Source Performance Standards for Asphalt Processing and Asphalt Roofing Manufacture" and the "Results of the Asphalt Processing and Asphalt Roofing Manufacturing NSPS Review."

Volatile Organic Compounds (VOC's) Capture Efficiency

The EPA is currently developing procedures for determining the volatile organic compound capture efficiency of devices such as hoods. Enclosed is the draft preamble and regulation.

Municipal Waste Combustion

Enclosed is the "Clean Air Act Section 111(b) and 111(d) Regulatory Program for Municipal Waste Combustion-Draft Regulatory Development Plan" which outlines our approach for developing emission standards and emission guidelines for municipal waste combustors (MWC's). The new source performance standards for new and modified MWC's will be revised under Section 111(b) of the Clean Air Act to regulate selected criteria pollutants and one or more designated pollutants that are not regulated under Section 108 or 112 of the Act. The regulation of the designated pollutant(s) will invoke Section 111(d) for the issuance by EPA of a guideline document and emission guidelines for use by the States in developing emission standards for existing MWC's. The enclosed document highlights the major issues and control alternatives that will be considered in this rulemaking, and discusses the technical approach and types of analyses that will be developed.

Municipal Solid Waste Landfills

The EPA is developing regulations to control air emissions from municipal solid waste landfills. The enclosed package includes the draft background information document and an addendum (i.e., Chapters 8 and 9 and a case study analyses). Regulations are being developed to control air emissions from new and modified landfills using Section 111(b) of the Clean Air Act and from existing landfills using Section 111(d) of the Clean Air Act.

Treatment, Storage, and Disposal Facilities (TSDF)

Three items are enclosed regarding TSDF:

1. A draft paper entitled, "Preliminary Control Strategies for TSDF Air Emission Standards";
2. A two-volume set of a preliminary draft document entitled, "Hazardous Waste TSDF - Background Information for Proposed RCRA Air Emission Standards, Volume I-Chapters and Volume II-Appendices"; and
3. A draft paper on the test method we are planning to use for measuring the volatile organic content of wastes entitled, "Method for the Determination of Volatile Organic Content of Hazardous Wastes."

Perchloroethylene Dry Cleaning

The enclosed information on perchloroethylene dry cleaning consists of: an information briefing for regulatory alternatives and size cutoffs, Chapters 3-6 and Appendix D of the draft background information document, costs of controls, an economic impact analysis of regulatory controls, and occupational exposure information.

Ethylene Oxide Commercial Sterilizers

Enclosed is the preliminary draft document entitled, "Ethylene Oxide Emissions from Commercial Sterilization/Fumigation Operations-Background Information for Proposed Standards." Also, enclosed is a supplemental appendix to the document providing a summary of potential regulatory impacts as well as the methodology used to develop risks attributed to short-term exposures to ethylene oxide.

Small Steam Generating Units

Enclosed is the briefing material on small steam generating units which will be discussed at the meeting.

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April 11, 1988

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOMMEMORANDUM

SUBJECT: National Air Pollution Control Techniques Advisory Committee Meeting - Sheraton Imperial Towers and Hotel, Research Triangle Park, North Carolina (May 18 and 19, 1988)

FROM: Jack R. Farmer, Director /S/
Emission Standards Division (MD-13)

TO: See Below

The United States Environmental Protection Agency's (EPA) National Air Pollution Control Techniques Advisory Committee (NAPCTAC) will meet on May 18 and 19, 1988, to review the subjects shown on the attached agenda. The meeting will be held at the Sheraton Imperial Hotel and Towers in Research Triangle Park, North Carolina.

Attached is a summary of the documents which will be discussed at the NAPCTAC meeting. All of the documents listed on the summary are also attached. For your information, the meeting was announced in the Federal Register on March 28.

For your information, a block of rooms (special rate of \$60 a day) is being held at the Sheraton until May 2 for use by those who wish to stay where the meeting is being held. When making your reservations, please indicate that you will be attending the EPA meeting; the telephone number is (919) 941-5050. The Sheraton does provide a courtesy airport limousine.

Attachments

Addressees:

Louis Gitto, Region I
Conrad Simon, Region II
Thomas Maslany, Region III
Winston Smith, Region IV
Dave Kee, Region V
William Hathaway, Region VI
W. A. Spratlin, Region VII
Irwin Dickstein, Region VIII
David Howekamp, Region IX
Gary O'Neal, Region X

cc: With Agenda Only
OAQPS Division Directors
Regional Administrators (Region I-X)
Jerry Emison (MD-10)
Rob Brenner (ANR-443)
Don Clay (ANR-443)
Alex Cristofaro (PM-220)
Alan Eckert (LE-132A)
Joan LaRock (A-101)
Frank Princiotta (MD-60)

OAQPS: ESD: OD: MJClark: mjclark, rm 741, NCM, x5571 (MD-13): 4/11/88
bcc: Deb Michelitsch, ESD/ISB (3 copies) Dianne Byrne, ESD/SDB
Dennis Crumpler, ESD/CPB (3 copies) Sims Roy, ESD/SDB
Ron Myers, ESD/ISB (3 copies) Walt Stevenson, ESD/SDB
Susan Thorneloe, ESD/CPB (3 copies) Dianne Byrne, ESD/SDB
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Mark Meech, ESD/CPB (3 copies) Doug Bell, ESD/SDB
Dave Markwordt, ESD/CPB (3 copies) Laura Butler, ESD/SDB
Bill Maxwell, ESD/ISB (3 copies) Rick Copland, ESD/SDB

AGENDA

U. S. ENVIRONMENTAL PROTECTION AGENCY

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Sheraton Imperial Hotel and Towers
Empire Ballroom (A and B)
I-40 Exit 282 at Page Road
Research Triangle Park, North Carolina 27709

(919) 941-5050

MAY 18 AND 19, 1988

May 18 (Wednesday) - 9:00 a.m.

ASPHALT ROOFING

Review of Standards of Performance for New Stationary Sources
(Section 111 of the Clean Air Act)

VOLATILE ORGANIC COMPOUNDS (VOC's) CAPTURE EFFICIENCY

Test Methods and Procedures
(Sections 110 and 111 of the Clean Air Act)

MUNICIPAL WASTE COMBUSTION

Status Report to the Committee on Regulatory Development
(Sections 111 and 111(d) of the Clean Air Act)

MUNICIPAL SOLID WASTE LANDFILLS

Background Information and Regulatory Alternatives
(Sections 111 and 111(d) of the Clean Air Act)

TREATMENT, STORAGE, AND DISPOSAL FACILITIES (TSDF)

Background Information and Regulatory Alternatives
(Resource Conservation and Recovery Act)

PERCHLOROETHYLENE DRY CLEANING

Background Information and Regulatory Alternatives
(Section 112 of the Clean Air Act)

May 19 (Thursday) - 9:00 a.m.

CONTINUATION OF MAY 18--AS REQUIRED

ETHYLENE OXIDE COMMERCIAL STERILIZERS

Background Information and Regulatory Alternatives
(Section 112 of the Clean Air Act)

SMALL STEAM GENERATING UNITS

Status Report to the Committee on Regulatory Development
(Section 111 of the Clean Air Act)

Note: See reverse for current roster of the Committee.

4/5/88

U.S. ENVIRONMENTAL PROTECTION AGENCY

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Chairperson and Executive Secretary

Mr. Jack R. Farmer
 Director, Emission Standards Division (MD-13)
 Office of Air Quality Planning and Standards
 U. S. Environmental Protection Agency
 Research Triangle Park, North Carolina 27711

(919) 541-5572
 FTS: 629-5572

COMMITTEE MEMBERS

Mr. Thomas M. Allen, P.E.
 Associate Director
 Division of Air Resources
 New York State Department
 of Environmental Conservation
 50 Wolf Road - Room 128
 Albany, New York 12233-0001
 (518) 457-7230

*Mr. Donald R. Arkell
 Director
 Lane Regional Air Pollution Authority
 225 North 5th Street
 Springfield, Oregon 97477
 (503) 726-2514

*Mr. Bradley J. Beckham
 Director
 Air Pollution Control Division
 Colorado Department of Health
 4210 East 11th Avenue
 Denver, Colorado 80220
 (303) 331-8500

*Mr. Roger P. Hall
 Manager, Technical Information Center
 The Glidden Company
 Dwight P. Joyce Research Center
 16651 Sprague Road
 Strongsville, Ohio 44136
 (216) 826-5245

*Mr. James R. Martin
 Vice President
 Environmental Systems Division
 Combustion Engineering, Inc.
 31 Inverness Center Parkway
 Post Office Box 43030
 Birmingham, Alabama 35243
 (205) 991-2832

*Ms. Vivian M. McIntire
 Coordinator, Agency Relations
 Eastman Chemicals Division
 Eastman Kodak Company
 Post Office Box 511
 Kingsport, Tennessee 37662
 (615) 229-3045

Mr. Robert P. Miller
 Chief, Air Quality Division
 Michigan Department of Natural Resources
 Stevens T. Mason Building, Box 30028
 Lansing, Michigan 48909
 (517) 373-7023

Mr. Andrew H. Nickolaus
 Senior Environmental Control Consultant
 Engineering Division
 E. I. du Pont de Nemours & Company, Inc.
 Post Office Box 2626
 Victoria, Texas 77902
 (512) 572-1277

Mr. William M. Reiter
 President
 Cape Environmental Associates, Inc.
 Post Office Box 2162
 Ocean City, New Jersey 08226
 (609) 398-6506

Dr. Edward S. Rubin
 Director, CEES
 Professor of Mechanical Engineering
 and Public Policy
 Carnegie-Mellon University
 Schenley Park
 Pittsburgh, Pennsylvania 15213
 (412) 268-2491

*Ms. Deborah A. Sheiman
 Resource Specialist
 Natural Resources Defense Council
 1350 New York Avenue, N.W.-Suite 300
 Washington, D.C. 20005
 (202) 783-7800

*New Committee Member

April 7, 1988

SUMMARY OF MATERIALS DISTRIBUTED FOR REVIEW AT THE MAY 18 AND 19, 1988,
MEETING OF THE NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Asphalt Roofing

Enclosed are a preliminary draft of the "Review of New Source Performance Standards for Asphalt Processing and Asphalt Roofing Manufacture" and the "Results of the Asphalt Processing and Asphalt Roofing Manufacturing NSPS Review."

Volatile Organic Compounds (VOC's) Capture Efficiency

The EPA is currently developing procedures for determining the volatile organic compound capture efficiency of devices such as hoods. Enclosed is the draft preamble and regulation.

Municipal Waste Combustion

Enclosed is the "Clean Air Act Section 111(b) and 111(d) Regulatory Program for Municipal Waste Combustion-Draft Regulatory Development Plan" which outlines our approach for developing emission standards and emission guidelines for municipal waste combustors (MWC's). The new source performance standards for new and modified MWC's will be revised under Section 111(b) of the Clean Air Act to regulate selected criteria pollutants and one or more designated pollutants that are not regulated under Section 108 or 112 of the Act. The regulation of the designated pollutant(s) will invoke Section 111(d) for the issuance by EPA of a guideline document and emission guidelines for use by the States in developing emission standards for existing MWC's. The enclosed document highlights the major issues and control alternatives that will be considered in this rulemaking, and discusses the technical approach and types of analyses that will be developed.

Municipal Solid Waste Landfills

The EPA is developing regulations to control air emissions from municipal solid waste landfills. The enclosed package includes the draft background information document and an addendum (i.e., Chapters 8 and 9 and a case study analyses). Regulations are being developed to control air emissions from new and modified landfills using Section 111(b) of the Clean Air Act and from existing landfills using Section 111(d) of the Clean Air Act.

Treatment, Storage, and Disposal Facilities (TSDF)

Three items are enclosed regarding TSDF:

1. A draft paper entitled, "Preliminary Control Strategies for TSDF Air Emission Standards";
2. A two-volume set of a preliminary draft document entitled, "Hazardous Waste TSDF - Background Information for Proposed RCRA Air Emission Standards, Volume I-Chapters and Volume II-Appendices"; and
3. A draft paper on the test method we are planning to use for measuring the volatile organic content of wastes entitled, "Method for the Determination of Volatile Organic Content of Hazardous Wastes."

Perchloroethylene Dry Cleaning

The enclosed information on perchloroethylene dry cleaning consists of: an information briefing for regulatory alternatives and size cutoffs, Chapters 3-6 and Appendix D of the draft background information document, costs of controls, an economic impact analysis of regulatory controls, and occupational exposure information.

Ethylene Oxide Commercial Sterilizers

Enclosed is the preliminary draft document entitled, "Ethylene Oxide Emissions from Commercial Sterilization/Fumigation Operations-Background Information for Proposed Standards." Also, enclosed is a supplemental appendix to the document providing a summary of potential regulatory impacts as well as the methodology used to develop risks attributed to short-term exposures to ethylene oxide.

Small Steam Generating Units

Enclosed is the briefing material on small steam generating units which will be discussed at the meeting.

April 19, 1988

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Mr. John A. Paul
President, ALAPCO
Montgomery County Regional
Air Pollution Control Agency
Post Office Box 972
Dayton, Ohio 45422

Dear Mr. Paul:

The Presidents of STAPPA and ALAPCO are routinely notified of the National Air Pollution Control Techniques Advisory Committee (NAPCTAC) meetings. Since you have already been notified and mailed copies of the documents to be discussed at the May 18 and 19, 1988, meeting as a member of ALAPCO's New Source Review Committee, I am not sending you the notification letter we would normally send the current President of ALAPCO.

If you need additional copies of the documents for distribution to ALAPCO, please contact Mary Jane Clark at (919) 541-5571.

Sincerely,

/s/

Jack R. Farmer
Chairperson
National Air Pollution Control
Techniques Advisory Committee

cc: S. William Becker
Executive Director, STAPPA/ALAPCO

OAQPS: ESD: MJClark: mjclark, rm 741, NCM, x5571 (MD-13): 4/19/88

bcc: Deb Michelitsch, ESD/ISB (3 copies)	Dianne Byrne, ESD/ISB (3 copies/3 projects)
Dennis Crumpler, ESD/CPB (3 copies)	Sims Roy, ESD/SDB
Ron Myers, ESD/ISB (3 copies)	Walt Stevenson, ESD/SDB
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K. C. Hustvedt, ESD/CPB (3 copies)	Laura Butler, ESD/SDB
*Dave Beck, ESD/CPB (3 copies)	Rick Copland, ESD/SDB
Dave Markwordt, ESD/CPB (3 copies)	
Bill Maxwell, ESD/ISB (3 copies)	

*Mark Meech departed EPA on 4/15/88.

April 19, 1988

Mr. Donald Theiler
President, STAPPA
Wisconsin Department of Natural Resources
Bureau of Air Management
Box 7921
Madison, Wisconsin 53707

Dear Mr. Theiler:

The United States Environmental Protection Agency's (EPA) National Air Pollution Control Techniques Advisory Committee (NAPCTAC) will meet on May 18 and 19, 1988, to review the subjects shown on the enclosed agenda. The meeting will be held at the Sheraton Imperial Hotel and Towers in Research Triangle Park, North Carolina.

The NAPCTAC meetings are always open to the public, and you are invited to attend and participate in the discussions. Enclosed is a summary of the documents which will be discussed at the NAPCTAC meeting. All of the documents listed on the summary are also enclosed. The meeting was announced in the Federal Register on March 28, but we wanted you to have this information because of your interest in these subjects. Since there are several members of STAPPA on the Committee, we assume they will speak for your association at the meeting. (The NAPCTAC roster is shown on the back of the meeting agenda.) For your information, we also mailed copies of the documents to the members of STAPPA's Stationary Source Committee.

In order to properly plan the meeting, it is necessary for me to know prior to the meeting if you plan to make a presentation. Please call Mary Jane Clark at (919) 541-5571 by May 10 if you would like to make a presentation. If you do plan a presentation, please bring a copy of it to the meeting for our use in preparing the meeting minutes. If you wish to distribute your presentation to the Committee and staff, 25 copies will be sufficient. Written comments are certainly welcome, and we can schedule a meeting with your association to discuss your comments if you so desire.

For your information, a block of rooms (special rate of \$60 a day) is being held at the Sheraton until May 2 for use by those who wish to stay where the meeting is being held. When making your reservations, please indicate that you will be attending the EPA meeting; the telephone number is (919) 941-5050. The Sheraton does provide a courtesy airport limousine.

Sincerely,

JS/

Jack R. Farmer
Chairperson
National Air Pollution Control
Techniques Advisory Committee

20 Enclosures

cc: S. William Becker
Executive Director, STAPPA/ALAPCO

OAQPS: ESD:OD: MJClark: mjclark, rm 741, NCM, x5571 (MD-13): 4/19/88

bcc: Deb Michelitsch, ESD/ISB (3 copies)	Dianne Byrne, ESD/ISB (3 copies/3 projects)
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*Dave Beck, ESD/CPB (3 copies)	Rick Copland, ESD/SDB
Dave Markwordt, ESD/CPB (3 copies)	
Bill Maxwell, ESD/ISB (3 copies)	

*Mark Meech departed EPA on 4/15/88.

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 5/12/88, 6/13/88

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Donaldson Company, Inc.

Post Office Box 1299

1400 West 94th Street

Minneapolis, Minnesota 55440

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (612) 887-3131

Person(s) Contacted/Title(s)

Cary Olson

FILE COPY

CONTACT SUMMARY:

I called Mr. Olson to find out if the EtO Abator™ catalytic incinerator could be used at commercial sterilization facilities to control EO emissions from aeration rooms. He said that there were several commercial sterilization facilities which have EtO Abator™s installed for control of aeration room emissions. Among those facilities he mentioned are Seamless Hospital products (Texas and Florida), Davis & Geck (Division of American Cyanamid), 3M Corp. (South Dakota) and MG Industries (Pennsylvania). The following sizes of EtO Abator™ are available:

Smaller hospitals Cost, \$^a

50 ft ³ /min	15,000
125 ft ³ /min	23,000

Large hospitals, small commercial sterilization facilities--cost = \$37,000^a

500 ft³/min

Commercial size Cost, \$^a

1,000 ft ³ /min	60,000
3,000 ft ³ /min	97,000
6,000 ft ³ /min	140,000
9,000 ft ³ /min	192,000
12,000 ft ³ /min	240,000

CONFIRMATION	7/25/88
RESPONSE	Additions made
WRITTEN <input checked="" type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>	

^aThese costs are for units capable of handling both sterilizer and aeration exhaust. A unit for aeration only would be less expensive. Costs include heat exchanger (70 percent heat recovery), preheater, and prewiring; the facility is responsible for installation and ductwork.

Mr. Olson said that Seamless Hospitals Products facilities in Florida and Texas each use two EtO Abators™ (four total) to control aeration room emissions. [That is, two EtO Abators™ can be used to control emissions from one aeration room and therefore, the size of the aeration room is not a problem.]

The largest EtO Abator™ currently installed is a 3,000-ft³/min size. He said that the catalyst bed lasts for ~4 to 5 years before needing replacement.

Mr. Olson said that he would be at NAPCTAC on May 19 as well as Rich Porco who is Manager of Engineering at Donaldson. He also provided the following list of contacts at commercial sterilization facilities using the EtO Abator™ system:

- | | |
|--------------------------------------|--|
| 1. Seamless Rubber
El Paso, Texas | Chester Kennedy (915) 858-2937
(EtO Abator™ used to control aeration rooms) |
| 2. Seamless Rubber
Ocala, Florida | Carl Siepp (904) 732-0600
(EtO Abator™ used to control aeration rooms) |
| 3. Davis & Geck | George Lauri (203) 743-4451
(EtO Abator™ controls sterilizer exhaust only--there are three 200 ft ³ sterilizers at this facility) |
| 4. 3M
South Dakota | Chris Piper (612) 778-4620
(EtO Abator™ controls table-top sterilizer emissions, including aeration) |
| 5. MG Industries
Pennsylvania | George Timberlake (215) 630-5400
(MG Industries refills EO bottles [cylinders] and uses the EtO Abator™ to control the emissions of residual EO left in the used cylinders) |

Received 7/25/88

Attachment to 5/12/88
telecon w/ Donaldson Co.
(Cary Olson, Rebecca Nicholson)

June 17, 1988

FILE COPY

SYSTEM LOCATIONS

American Pharmaseal - American Medical Packaging
3 - 800 SCFM systems aeration
1 - 400 SCFM system - sterilizer and aeration

American Cyanamid
Lederle Labs
800 SCFM - 126 ft³ sterilizer & aeration

Davis & Geck
3000 SCFM - 3 200 ft³ sterilizers

George Lauri
203-743-4451

Children's Hospital - Pennsylvania
1900 SCFM - 4 sterilizers and aeration

Richard Ewing
215-596-9782

Paoli Hospital - Pennsylvania
550 SCFM - sterilizer

Chris Ruiz
215-648-1280

Seamless Rubber

Texas
2 - 2000 SCFM aeration

Chester Kennedy
915-858-2937

Florida
2 - 2000 SCFM aeration

Carl Siepp/Tony Ryerson
904-732-0600

3M Company - South Dakota
500 SCFM - 2 sterilizers and aeration

Chris Piper
612-778-4620

M-G Industries - Pennsylvania
1600 SCFM - EtO bottle refilling

George Timberlake
215-630-5400

Madison V.A. Hospital - Madison
125 SCFM - 2 sterilizers and aeration

Storz Ophtalmics - Florida
500 SCFM - Sterilizer and aeration

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: May 13, 1988

Contacted by: Telephone

RECEIVED

Company/Agency: Donaldson Company, Inc.
1400 West 94th Street
Post Office Box 1299
Minneapolis, Minnesota 55440

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (612) 887-3131

Person(s) Contacted/Title(s)

FILE COPY

Darrell Jahn, Senior Project Engineer

CONTACT SUMMARY:

I called Cary Olson again to ask him about the "lower limits" (i.e., EO concentrations) of the EtO Abator™, but he was on vacation; therefore, I was referred to Darrell Jahn who is a Senior Project Engineer at Donaldson Company, Inc.

Mr. Jahn told me that there is no "lower limit" on the ppm of EO that can be treated with the EtO-Abator™. The EtO-Abator™ works just as well at the higher concentrations as it does with the lower EO concentrations. However, he said that the 99.9 percent efficiency of the EtO-Abator™ is harder to prove at the lower inlet concentrations of EO. The presently used analytical instrumentation for EO detection is limited by its detectability limit of 0.5 nanograms. He added that they (Donaldson Company, Inc.) are currently doing laboratory testing to determine the removal efficiencies at very low EO inlet concentrations.

I also asked Mr. Jahn if the EtO Abator™ units are run continuously. He said that the facility decides how long they need to run their unit (in order to meet OSHA requirements.)

CONFIRMATION	7/25/88
RESPONSE	Additions made
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 6/13/88

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Becton, Dickinson and Company, OAQPS AIR
Route 7, Grace Way DOCKET CONTROL ROOM
Canaan, Connecticut 06018

Telephone Number: (203 824-5487, ext. 363

FILE COPY

Person(s) Contacted/Title(s)

Robert M. Leonard, Manager, Engineering

CONTACT SUMMARY:

I called Mr. Leonard to reaffirm that Becton, Dickinson and Company no longer uses ethylene oxide at their Connecticut facility. Mr. Leonard confirmed that the use of ethylene oxide was discontinued in July 1986. The facility now sterilizes products using Cobalt 60 and electron beam radiation.

CONFIRMATION	7/11/88
RESPONSE	
WFL <input checked="" type="checkbox"/>	
VERO/L <input type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 6/14/88

Contacted by: Telephone

Company/Agency: Advanced Air Technologies, Inc.
710 S. McMillan Street
Owosso, Michigan 48867

RECEIVED
AUG 26 1997
OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (517) 723-2171

Person(s) Contacted/Title(s)

Richard Kruse , David Hammer (consultant to Advanced Air)

FILE COPY

CONTACT SUMMARY:

I called Mr. Kruse to obtain information about Advanced Air Technologies' "SAFE-CELL" ethylene oxide control device. Mr. Kruse described the SAFE-CELL unit as having two stages. Stage 1 is an acid-water scrubber and Stage 2 is a dry bed reactor which operates at room temperature. The control device can be sold as a "set" (i.e., both stages) or either stage of the system can be purchased separately.

Mr. Kruse said that currently three hospitals and one industrial sterilization facility (a Sterijet™ user) have one or both stages. (Two hospitals and industrial sterilizer are located in Michigan). He said that the State of Michigan will require that ethylene oxide (EO) concentrations be below 1.6×10^{-5} ppm. He also stated that reliable detection methods are not available for measuring EO concentrations that low. Mr. Kruse said that the efficiency of the first stage of the SAFE-CELL™ system is about 99.9 to 99.99 percent. The second stage handles large air flow volumes and produces air with typically less than 0.1 ppm ethylene oxide. He provided the following information on the current users of the SAFE-CELL™ system:

Michigan hospital 1: Currently uses the Stage-2 unit to control drain emissions.

Michigan hospital 2: Currently uses the complete SAFE-CELL™ system (Stages 1 and 2) to control EO emissions from the sterilizer and aeration room. The unit is sized at 300 to 350 cubic feet per minute, ft³/min.

Industrial sterilizer: Will install a Stage-2 system to control EO emissions from a Sterijet sterilizer. System should have been installed 2 weeks ago. Have received verbal approval from State of Michigan, but need written approval prior to installation. Unit will handle flows of ~450 to 500 ft³/min.

I asked Mr. Kruse if units larger (i.e., to handle higher flowrates) than those currently being used were available. He said that units can be made to handle larger flowrates but the physical dimensions may become impractical. He estimated that the space requirements for a 1,000 ft³/min unit would be about 6 (ft)x7 (ft)x8 (ft) (336 ft³).

I also asked Mr. Kruse if his company had any type of contract with users of the Stage 1 (scrubber) system to buy the ethylene glycol produced by the scrubber. He said that there is currently no contract for that purpose and felt that users of the system should have no problems with ethylene glycol disposal.

Mr. Kruse agreed to send additional information on costs, control device users and equipment specifications [see attachments].

CONFIRMATION	8/02/88
Confirmed by fax	
by David Hammer	
X	

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: June 23, 1988

Contacted by: Telephone

Company/Agency: South Coast Air Quality Management District
9150 Flair Drive
El Monte, California 91731

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (818) 571-5158

Person(s) Contacted/Title(s)

George Ames

CONTACT SUMMARY:

I called Mr. Ames regarding comments about the ethylene oxide (EO) background information document that EPA had received from Robert Pease of SCAQMD in a letter dated September 16, 1987. In those comments, Mr. Pease stated that a facility in SCAQMD's jurisdiction had installed an impregnated carbon adsorption system to control aeration emissions. Mr. Ames replied that the facility Mr. Pease referred to had conducted a pilot study for the control of aeration room emissions using a custom-designed carbon adsorption system designed specifically for the study. He was hesitant to discuss further details of this study with me but said that he would provide additional information to EPA if contacted.

In the September 1987 letter, Mr. Pease also stated that test results for a flare at a commercial sterilization facility in the South Coast district indicated an efficiency greater than 99.99 percent. Mr. Ames would not provide any details about these tests but said that he would give the information to EPA if contacted.

Mr. Ames and I also discussed the use of closed-loop, water-sealed vacuum pumps. Mr. Ames said that most hospitals still use once-through water-sealed pumps but that most commercial sterilizers now use oil-sealed pumps. Mr. Ames stated that the main problem with closed-loop, water-sealed pumps is that a "large amount" of water (from humidification of the sterilizer air) condenses in the vacuum pump causing the reservoir tank (from the gas/liquid separator) to overflow. This overflow, which may contain dissolved EO, usually is discharged to the sewer.

CONFIRMATION	Sent 02/24/89
RESPONSE	
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

CONTACT REPORT--MRI Project No. 7723-K

From: Rebecca Nicholson, Environmental Engineering Department

Date of Contact: 6/13/88, Revised 7/19/88

Contacted by: Telephone

Company/Agency: Tigg Corporation
Post Office Box 11661
Pittsburgh, Pennsylvania 15228

Telephone Number: (412) 563-4300

Person(s) Contacted/Title(s)

Bob Byron

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM**FILE COPY****CONTACT SUMMARY:**

I called Mr. Byron to find out if Tigg Corp. had any ethylene oxide (EO) control devices installed in hospitals or commercial sterilization facilities. Mr. Byron said that they have sold two EO control devices to a contractor who provides fumigation services to museums and libraries with mobile equipment. These control units have a chemically prepared reactant/adsorbant bed to control EO emissions (in the process, the EO is converted to ethylene glycol).

I asked Mr. Byron if Tigg Corporation planned to design and install EO control systems for hospitals and/or commercial sterilization facilities in the near future. He said that they have not pursued the EO market because of time constraints and because of the demand for control technologies by other industries; Tigg Corp. is currently involved in the control of VOC's and groundwater contamination. He added that Tigg Corp. has the capability of addressing the EO market and generally designs the control units specifically for the user facility.

Mr. Byron agreed to send literature on the adsorbers and cost information (see attachment).

CONFIRMATION	7/17/88
RESPONSE	2 attachments
<input checked="" type="checkbox"/> WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE	

TIGG CORPORATION

TIGG

bx 11661 • Pittsburgh, Pennsylvania 15228 • Telephone: (412) 563-4300 • Telex: 269312 (RCA) TIGG PITT • Cable: TIGGCOR PITTSBURG

RECEIVED JUN 17 1988

June 14, 1988

Ms. Rebecca Nicholson
Mid West Research Institute
Suite 350
401 Harrison Oaks Blvd.
Cory, NC 27573

~~FILE COPY~~

Dear Rebecca,

Confirming our telephone conversation, you will find technical literature for NIXTOX modular adsorbers enclosed. Current pricing for applicable models is also enclosed.

We hope that this information will be helpful to you. Please let us know if you have any further questions, or when we may provide adsorption equipment for your needs.

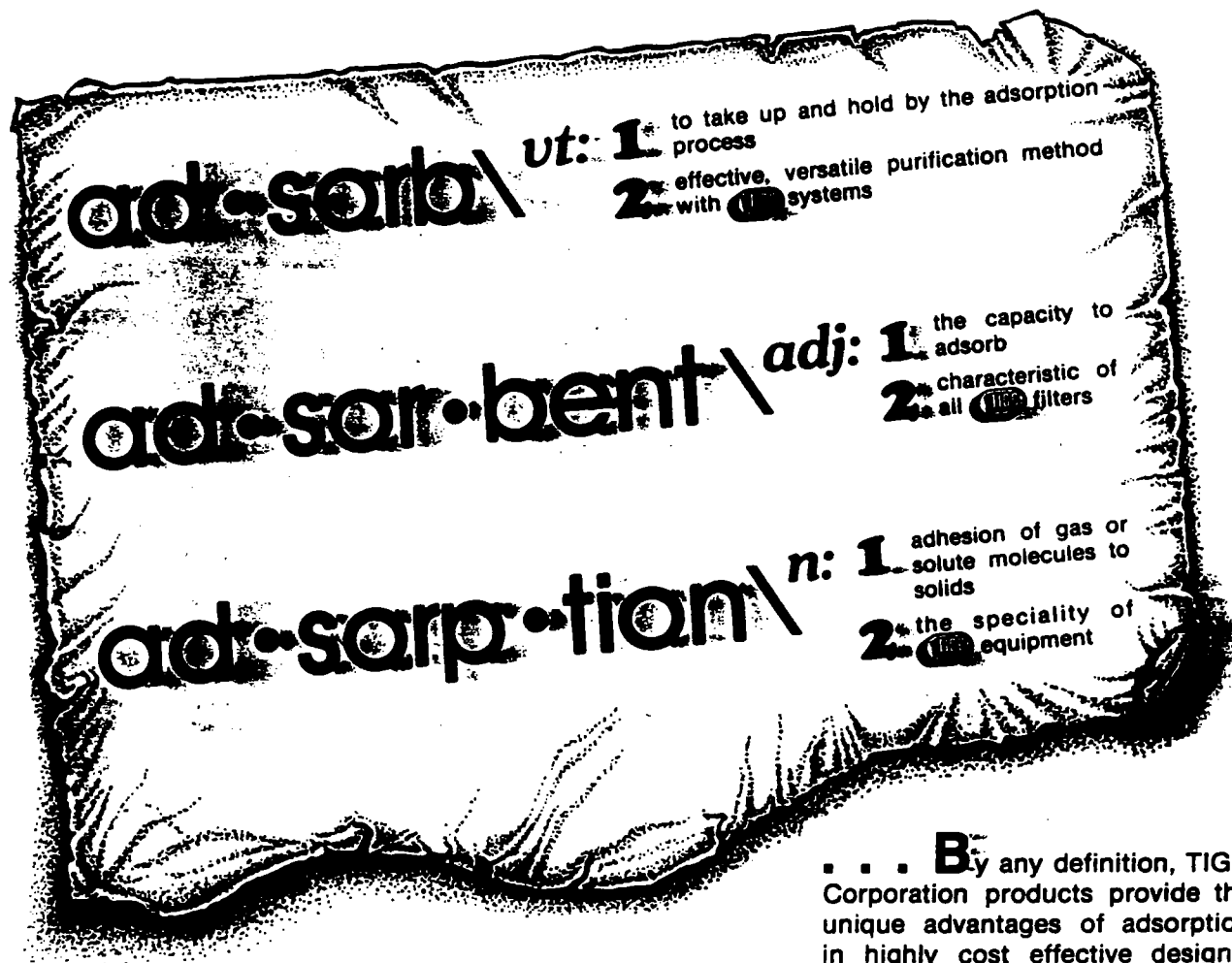
Very truly yours,


R.S. Byron

RSB:dmq
enclosures

MODULAR ADSORBERS

ACTIVATED CARBONS, OTHER SORBENTS



FILE COPY

NIXTOX[®]

AIR POLLUTION CONTROL,
PROCESS GASES

CANSORB[®]

WATER POLLUTION CONTROL,
PROCESS LIQUIDS

ENVIROSORB[®]

LABORATORY, INDUSTRIAL
AND MEDICAL WORK SPACE

TIGG

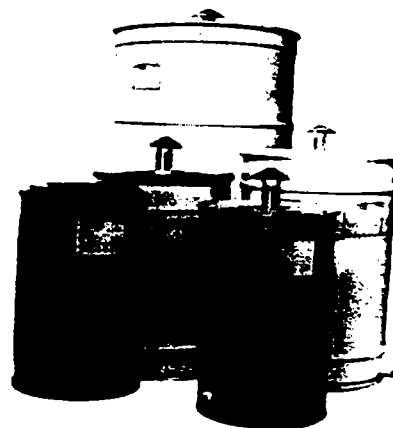
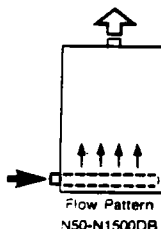
NIXTOX[®] MODULAR ACTIVATED CARBON ADSORBERS FOR AIR POLLUTION CONTROL. PROCESS GASES

Cost effective, preengineered units for permanent and disposable adsorber needs.

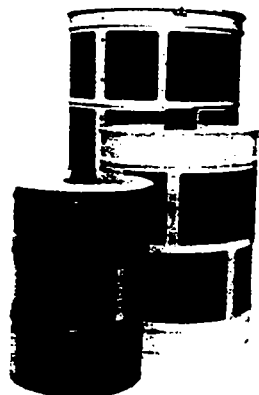
- Soil Venting
- Tank/Separator Vents
- Air Exhausts
- Vacuum Pump Exhausts
- Drumming Stations
- Sewage Odors
- Air Stripper Discharges

NIXTOX Disposable/Refillable Models to 1500 CFM N50, 100 & 100XP, 150, 250; N500DB, 750DB, 1500DB.

Economical deep bed units may be refilled or discarded with spent adsorbent. Model numbers designate maximum flow in CFM. All feature TIGG's patented vapor distributors to permit full adsorbent utilization and peak removal efficiency, at low pressure drop and low operating cost (for example, N100, 55 gallon, contains 40% more adsorbent than competitive models with gravel bed supports, giving N100 improved performance and service life, half the flow resistance and lower shipping weight). Rain shields and condensate drains are standard. Saturation indicator option shows when the unit is about 70% exhausted, minimizing test expense, excess inventory, and noncompliance concerns. Standard construction is corrosion resistant steel with stainless distributor. N100XP is built of cross-linked polyethylene for extraordinarily corrosive duty. D.O.T. Specification 34. N100 is a D.O.T. 5B hazardous waste container.

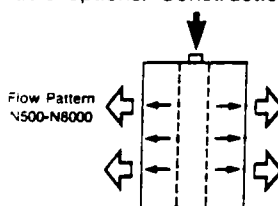


Left to right: (Foreground) N100 XP, N100; (Middle) N150, N250; (Rear) N500 DB. Smaller N50 and larger N750DB, N1500 DB are not shown.



NIXTOX Radial Flow Models to 8000 CFM N500, 1000, 1500, 3000, larger segmented models

This popular design treats large flows at very low pressure drop and small space requirements. Flow is from a central stainless screened distributor, outward through adsorbent, exhausting through side stainless screened ports to atmosphere or into cabinets at right. Flow may be reversed as preferred. Units in this series are normally recharged, with arrangements of disposable units used if adsorbent and vessel are to be discarded together. Condensate drains are standard; saturation indicators are available options. Construction is corrosion resistant steel, with stainless steel available on special order. N3000 is the largest standard unit, with special segmented versions of the design available for larger flows as ordered.



Front to rear: N500, N1000, N3000. N1500, with the same external appearance and size as N1000, is not shown. Similar larger N5000, N8000 are not shown.

Accumulator Cabinets

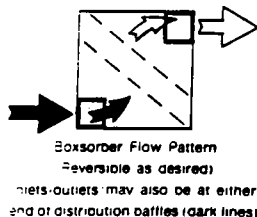
To collect flow from radial units at left, for direction to exhaust stack, downstream processing or recycle. Roller conveyors (except N3000, which requires forklift) assist in adsorber placement. Cabinets include gasketed door, adsorber retainer chain, pressure relief disc, inlet/outlet stacks, flex connection for adsorber inlet, and condensate drain. Construction is steel finished with catalyzed high solids epoxy.



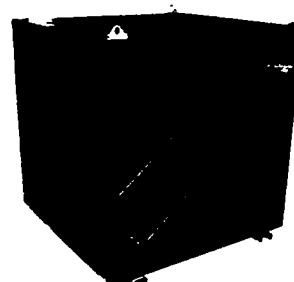
Accumulator Cabinets for N500, left, and N1000/1500. The cabinet for N3000 is of similar appearance but of larger size.

NIXTOX BOXSORBER[™] Models to 4000 CFM Boxsorber 6x6, 8x8

Newest of the NIXTOX series, BOXSORBER (Patent Applied) facilitates rapid response to spills and other heavy adsorption workloads. Standard units are cubic, six or eight feet on a side, suitable for flows to 2200 and 4000 CFM respectively. The unique design adapts well to trailer mounting; or permanent installation on leg assemblies supplied by TIGG. The diagonal adsorbent bed allows complete removal of spent material by gravity, with provisions for collection in drums or larger containers. Top hatches permit adding fresh adsorbent by gravity or airveying equipment. BOXSORBER features a proprietary inlet/outlet baffle design to produce even flow distribution over varied flow rates, at minimal flow resistance. Units may be operated upflow or downflow, singly or in series, with air inlet/outlet provisions at front, back or at either end. Condensate drains, pressure relief disc, lifting and tie-down lugs and inspection



hatches are standard. Construction is catalyzed high solids epoxy coated steel with stainless steel adsorbent screens. All-stainless units are available on special order.



Boxsorber 8x8 during fabrication: prior to installing air and adsorbent inlets/outlets, showing the unique diagonal adsorbent retaining/discharge system.

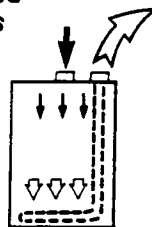
CANSORB®

MODULAR ACTIVATED CARBON
ADSORBERS FOR WATER POLLUTION
CONTROL, PROCESS LIQUIDS

The wide selection of activated carbon CANSORBs is also supplied with activated aluminas, molecular sieves and ion exchange resins as purification needs require.

- Waste Minimization
- Aquifer Remediation
- Laboratory Wastes
- Process Streams/Solvents
- Spill Control
- Protect IX, RO Units
- Waste Water/Wash Water
- Radioactive Waste Water
- Pump Tests

Flow pattern—
all CANSORB models



Left to right: (Foreground) C15, C15XP;
(Middle) C20, C25, (Rear) C50.
C5, C35, C100 and C200 not shown.

Disposable/Refillable CANSORB Models to 200 GPM

C5, 15 & 15XP, 20, 25, 35, 50, 100, 200.

Model numbers give maximum design GPM for water and other low viscosity liquids. Maximum flow may be lower for viscous liquids or to obtain ultralow impurity levels through extended adsorbent: liquid contact time. A patented liquid collection system promotes even flow distribution for efficient purification and adsorbent utilization, at low flow resistance. Construction is double epoxy/phenolic or high solids epoxy lined steel. The C15XP vessel is cross-linked polyethylene for severely corrosive duty, D.O.T. Specification 34. C15 is a D.O.T. 5B hazardous waste container. These units are particularly useful for collecting hazardous organic and radioactive wastes.

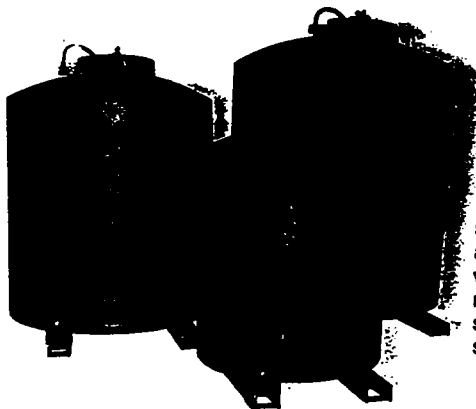
Polyethylene-Lined CANSORB HDS Models to 200 GPM

C25HDS, 35HDS, 50HDS, 75HDS, 100HDS, 200HDS.

Designed for permanent installation or reuse on successive field jobs, HDS units have the flow geometry advantages described above, with extra refilling convenience due to separate adsorbent make-up and spent adsorbent discharge fittings. Model numbers refer to maximum water viscosity GPM per unit (see contact time comments above). Construction is heavy steel shell completely lined with thick HD polyethylene. The separate adsorbent addition fitting and bottom side discharge valve allow refilling without disconnecting liquid piping or removing the bolted flange top. Units include fork channels for handling, which double as a self-contained installation skid.



Left to right: C50HDS, C100HDS, C75HDS,
C25HDS, C35HDS, C200HDS not pictured.



Left to right: C75SSL, C50SSL, C100SSL,
C25SSL, C35SSL, C200SSL not shown.

CANSORB SSL Stainless Steel Models to 200 GPM

C25SSL, 35SSL, 50SSL, 75SSL, 100SSL, 200SSL.

Dished head and bottom SSL models are constructed of 304 L stainless steel, with separate adsorbent replacement fittings and liquid collection/flow advantages as described for HDS units above. All-welded construction is suited for permanent installations, transport for repeat use at various point sources, or quick-response trailer mounting. Larger units are provided with access manways, and all SSL models include steel skids for fork truck handling and support after installation. Model numbers give maximum design water flow, although operational flow may be subject to contact time considerations as well.

See Specifications and Properties page for details
on CANSORB models.

U.S. PATENT 4,379,750

CANADA PATENT 1,197,075

WARRANTY

TIGG Corporation warrants these products to be in accordance with specifications and descriptions herein. Due to the wide variety of possible applications and conditions of use, no additional express or implied warranty is made for performance, safety, or suitability for particular purpose.

ENVIROSORB® LABORATORY, INDUSTRIAL AND MEDICAL WORK SPACE ADSORBENT AIR FILTERS

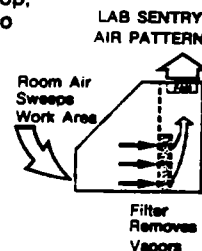
Activated carbon, other sorbent filters minimize exposure to:
Odors • Plastic Monomers • Metal Vapors • Anesthetics • Formaldehyde • Ammonia



The EL-2 LAB SENTRY model is pictured. The larger EL-3 BENCH SENTRY™, for electronic soldering and other work stations, is of similar design. Specifications on other side of this page.

ENVIROSORB® LAB SENTRY™ Adsorbent Air Filter

For laboratories in which dedicated fume ventilation is not available, or in which hazardous vapors require control prior to the chemical hood system. LAB SENTRY™ may be placed on counter or bench top, under a standard hood, or may be fitted with connections to an exhaust duct. Construction is of brushed stainless steel, with tempered safety plate observation window. The unit includes switch for work light and quiet electronic fan, electrical plug and cord, spill tray, filter grille, rinsable dust filter, and activated carbon or other sorbent filter.



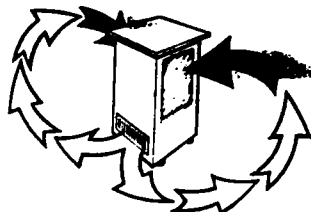
Tigg ADSORBOND™ Bonded Activated Carbon Filters

ENVIROSORB® laboratory and room air filters are available with an innovative adsorbent system in which the exclusive ADSORBOND™ process unites adsorbent particles into a porous panel. The result is a lighter, dust free filter that eliminates handling spent adsorbent; since the entire panel is fully disposable and combustible for safety and convenience. Replacement ADSORBOND™ panels, or steel-framed punched plate panels for loose adsorbent particles, are available from TIGG.

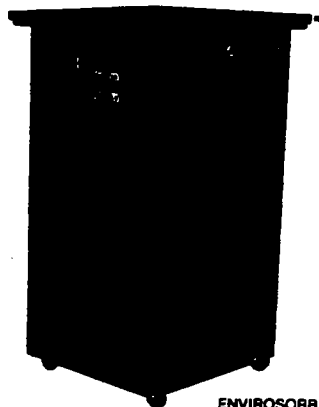
ENVIROSORB® ODOR MAGNET™ Room/Work Space Adsorbent Air Filter

For spaces in which air fresheners or small activated carbon filters are insufficient. Typical applications include hospital and nursing home rooms, indoor pollution common to energy-conserving buildings, or areas in which workers are exposed to uncomfortable levels of anesthetics, solvents, fragrances or similar occupational contamination. Construction is pebbled aluminum with stainless steel top for work or shelf surface. Casters provide easy movement over carpeted floors. A resilient bumper avoids damaging walls or furniture. The unit contains dual rinsable dust filters and active carbon panels. A unique air pattern produces effective air exchange and odor control at minimal power and noise level. Included are night light, electrical outlet for radio/TV or humidifier, and rheostatic control for varied fan speed.

Industrial versions may be ordered without night light, electrical outlet.



—A customer put it best:
"It's like opening a window,
but without the energy loss."



ENVIROSORB ODOR MAGNET
See reverse of this page for specifications.

ODOR MAGNET
AIR EXCHANGE PATTERNS
Indicated Flow Duplicated
On Other Side Of Unit

CAUTIONS

NIXTOX - Certain airborne materials such as ketones can undergo oxidation, polymerization or other chemical reactions with, or in the presence of, activated carbon (activated charcoal), often with the liberation of heat. If there is doubt concerning the compatibility of activated carbon in your application, TIGG Corporation will be happy to comment or to supply a sample of adsorbent for appropriate tests. NIXTOX is not recommended for ozone or concentrated oxidants such as oxygen or chlorine. If a NIXTOX unit is to be connected to a source of flammable material, the precautionary use of a suitable flame arrestor in the connection line is recommended.

CANSORB filter piping should be pressure relieved, particularly if the adsorbents are fed by a positive displacement pump or other potential sources of high system pressure in upset conditions. Similarly, CANSORB units should be vented during extended shut-downs, to relieve gases that might result from biological action on adsorbates.

ENVIROSORB LAB SENTRY, BENCH SENTRY and ODOR MAGNET filters are designed to reduce concentrations of adsorbable odors and other undesirable adsorbable gases and vapors. This largely esthetic purpose is not intended to substitute for good safety or ventilation practices, nor to substitute for devices such as individual respirators or filters designed to remove poorly adsorbed substances such as carbon monoxide.

LOW OXYGEN HAZARD - Moist activated carbon rapidly removes oxygen from air, creating an extreme hazard for workers inside adsorber vessels or in other poorly ventilated spaces. Good safety procedure demands that any activated carbon in a restricted space be assumed to have lowered oxygen to hazardous levels. All sampling, safety procedures and regulations for low oxygen environments should be followed.

Lifting Adsorbents - As further explained by labels on the units, hoist fittings on lids of larger NIXTOX (DB series), CANSORB and CANSORB HDS units are for assistance in removing lids only, not for lifting the entire unit. Fork lifts or appropriate slings under the unit should be used to lift all but the following models, which have standard lifting lugs: NIXTOX N1500DB, BOXSORBER 6 x 6, BOXSORBER 8 x 8.

SPECIFICATIONS and PROPERTIES

- TIGG products use no recycled materials or adsorbents. Installation/Operating instructions sent with each unit.
- Standard adsorbents are activated carbons. See *SELECTIVE ADSORPTION* on back page for other sorbents offered.

Unit	Design CFM (GPM)	Maximum psig. (a)	° F	Connections NPT (Duct)	Diameter/Height, Inches (b)	Adsorbent pounds	Minimum Contact, (c) Sec. (Min.)	Shipping (d) Pounds
NIXTOX (e)								
N150	150	10	350	2" M	27/40	300	3.9	385
N250	250	8	350	2" M	32/44	400	3.1	540
N500DB	500	6	350	4" M	57/67	1900	7.4	2375
N1000	1000	Open	350	(6")	32/44	400	0.8	565
N1500	1500	Open	350	(7")	32/44	300	0.4	475
N3000	3000	Open	350	(10")	48/72	1600	1.1	2050

CANSORB

C20	(20)	12	230	1" F	27/40	225	(3.1)	310
C25	(25)	8	230	1 1/4" F	32/44	300	(3.3)	415
C35	(35)	8	230	1 1/2" F	47/54	1000	(7.9)	1420
C25HDS/C25SSL	(25)	12	165/230	1 1/4" M	33/49	300	(3.3)	635
C35HDS/C35SSL	(35)	12	165/230	1 1/2" M	42/55	600	(4.8)	1140
C50HDS/C50SSL	(50)	12	165/230	2" M	47/55	800	(4.4)	1440

- (a) Per unit. Series pressure additive on upstream unit(s).
 (b) Primary adsorber vessel. Stacks or fittings, premounted fans, skid supports change overall dimensions.
 (c) Superficial at maximum flow.

- (d) Active carbon basis. Other adsorbents, prewetting, premounted fans will change.
 (e) Available with nonsparking fans, explosion proof motors.
 (f) Adsorbent normally shipped to fill on-site.

ENVIROSORB

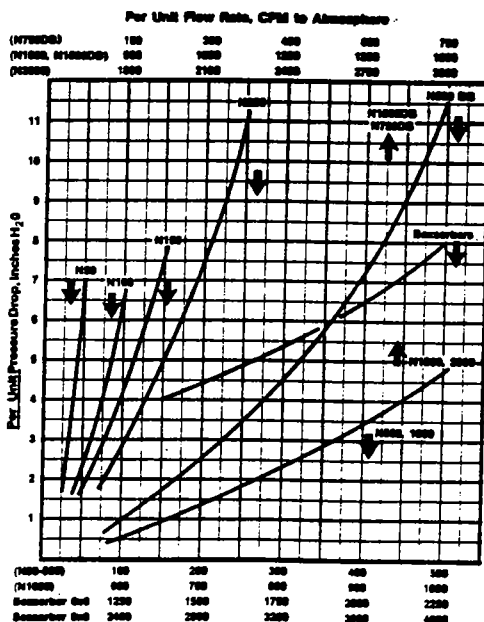
	CFM	Volts/Hz	Amps	L/W/H, inches	Shipping lbs.	Note: 20% lower CFM at 50 Hz.
LAB SENTRY	25	115/50-60	0.1	22/20/15	43	
BENCH SENTRY	45	115/50-60	0.2	30/28/20	58	
ODOR MAGNET	125	115/50-60	1.0	18/18/31	48	

STANDARD ACTIVATED CARBONS

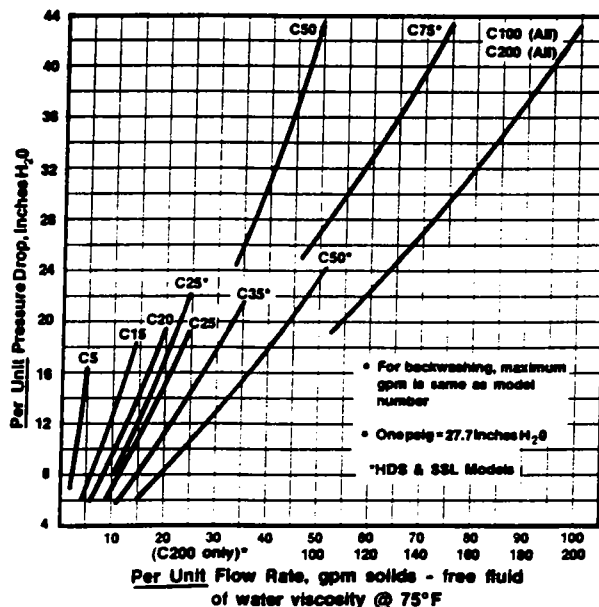
Type	Iodine No. mg./g. min.	Carbon Tetrachloride Weight % min.	Molasses No. min.	U.S. Sieve 90% min.	Bulk Density lbs./cu. ft. approx.
TIGG SC 0410 (NIXTOX)	1050	60	—	4 X 10	31
TIGG SD 1240 (CANSORB)	1000	—	230	12 X 40	27
ENVIROSORB	1050	60	—	4 X 8	31

FLOW RESISTANCE

NIXTOX MODELS



CANSORB MODELS



OPERATIONAL NOTES

• PREDICTING ADSORPTION PERFORMANCE

TIGG Corporation's proprietary ADSORPTION PREDICTIVE TECHNIQUE (APT)[™] computer programs can be very helpful outlining the activated carbon requirements for given air or water purification applications. The programs are derived from experimental data, but are based on fundamental correlative relationships that link adsorption by carbons of known characteristics to the properties of individual contaminants. Thus given a complete and accurate analysis (generalized descriptions such as VOC, BOD, or COD are not useful, but ppm or ppb analyses of individual components are) of the expected impurities in a defined flow, the resulting adsorbent needs can be predicted. The resulting savings in time and test expense may be significant. A modest charge is made for this service, reimbursable on purchase of TIGG adsorbents.

• SELECTIVE ADSORPTION

Activated carbons are very versatile adsorbents, such that it would be impractical to list the many thousands of adsorbable organics. In general, the higher an adsorbate's molecular weight and the lower its vapor pressure or water solubility versus other components or the carrying stream, the more physical adsorption is enhanced. In addition, chemisorbents have been developed to remove certain problem materials that would otherwise be poorly adsorbed, including hydrogen sulfide, lighter mercaptans and amines, ammonia, formaldehyde, mercury vapor and some radioactive compounds. TIGG also employs activated aluminas, ion exchange resins, molecular sieves and other desiccants according to the purification challenge.

• ACCESSORIES/OPTIONS

NIXTOX and CANSORB models are available with fan/motor or pump/motor combinations, rigid or flex prepping, valves, quick disconnects, prefilters, postfilters, totalizers, rotometers, flame arrestors, temperature and pressure gauges, adsorbents pretreated with water or other process fluids, specialized adsorbents and chemisorbents.

• INSTALLATION/OPERATION

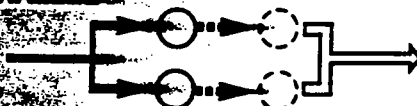
All NIXTOX, CANSORB and ENVIROSORB models include the initial adsorbent fill and arrive ready for operation. NIXTOX units typically go on stream immediately, while CANSORB models are usually liquid backfilled and then put in service. ENVIROSORB models need only be unpacked and plugged into an electrical outlet. Detailed instructions are sent with each unit. For NIXTOX and CANSORB, common adsorber configurations are:

SINGLE



Tank vent, odor control
and some water needs.

PARALLEL



For high flow rates or
greater contact time.

SERIES



To fully saturate
upstream unit(s).

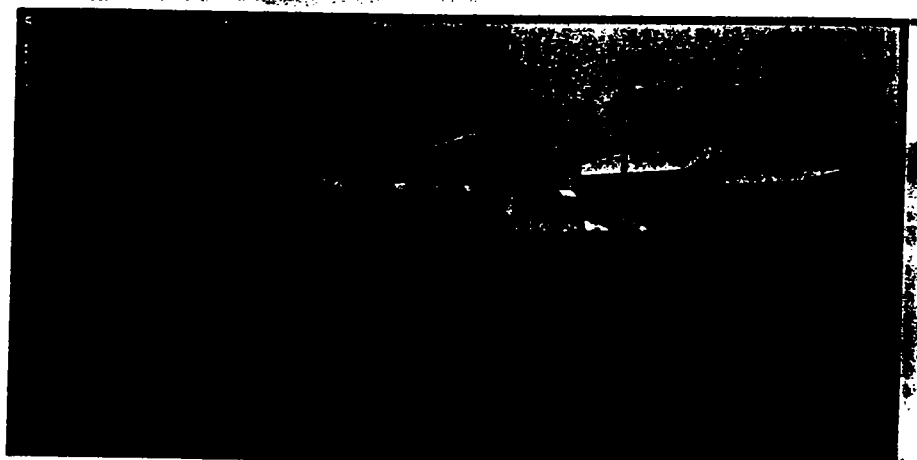
REPLACEMENT/RECHARGING

Many NIXTOX and CANSORB models may be replaced when permitted by economics of extended service life or for added convenience in disposing of wastes. N100 and C15 convert to D.O.T. 5B hazardous waste containers. NIXTOX and CANSORB have no gravel, screens or other loose components to complicate removing spent adsorbent or refilling vessels. Larger NIXTOX and CANSORB units are most conveniently emptied by water/adsorbent slurry or vacuum wand; BOXSORBER by gravity. Make-up adsorbents are available from TIGG. Replacement of ENVIROSORB filters is simply a matter of removing the spent filter panel and replacing or refilling it.

Spent adsorbent may be discarded, added to boiler coal or otherwise incinerated, or may justify reactivation if available in sufficient volume. The disposal method may be governed by the nature of adsorbate(s) on the spent material.

SPECIAL PRODUCTS/SERVICES

TIGG can design and fabricate products with custom modifications, to produce private label or other unique adsorption products and systems. TIGG designs have won *IR 100* and *Pollution Engineering's* 5-Star Product Advancement awards. The ADSORBOND bonding process creates additional innovative adsorption possibilities. If these capabilities might help solve a unique problem or attain your marketing goals, please write or call.



NIXTOX, CANSORB and ENVIROSORB filters are shipped F.O.B. TIGG Southcentral Operations, Heber Springs, Arkansas. This modern facility is dedicated solely to the fabrication of adsorbent products, modular adsorbents, and adsorption systems.

TIGG

TIGG CORPORATION

BOX 11661

PITTSBURGH, PA 15206

TELEPHONE: (412) 563-4300
TELEX: 269312 TIGG PITT (RCA)
CABLE: TIGGCOR PITTSBURGH
TELEFAX: (412) 563-6155

PRICE SCHEDULE

FILE COPY

NIXTOX[®] MODULAR ADSORBERS, Replacement Activated Carbons, Accessories^(a)

- Adsorber prices include initial fill with virgin TIGG 5C 0410 activated carbon.
- Pricing FOB Heber Springs, Arkansas; terms net 30 days; U. S. Funds.

<u>Price/Unit</u>	<u>1-3</u>	<u>4-9</u>	<u>10+</u>	<u>Lbs. fill</u>	<u>Type</u>
N 50	\$ 415	405	395	110	Closed - upflow
N 100 VS ^(b)	585	575	560	150	" "
N 100 & N 100 XP ^(c)	665	655	640	200	" "
N 150	1105	1065	1040	300	" "
N 250	1530	1470	1445	400	" "
N 500 DB	6555	6405	6345	1900	" "
N 750 DB	11060	10870	10725	3200	" "
N 1500 DB	17875	17625	17525	5700	" "
N 500	1225	1175	1135	200	Radial
N 1000	2325	2245	2190	400	"
N 1500	2270	2190	2135	300	"
N 3000	7010	6840	6730	1600	"
Boxsorber 6/6	12600	12300	12150	3000	Closed - transverse
Boxsorber 8/8	18815	18300	18050	5300	" "

Special Units:

HSS or HP Adsorbents - All quantities; add \$310 for each 200 lbs. fill given above; e.g. for one N 150; \$1105 + 1.5(\$310) = \$1570. Type HSS is extra selective for hydrogen sulfide and lighter mercaptans, Type HP for ammonia and lighter amines.

Models containing activated aluminas, molecular sieves or other specialized desiccants and adsorbents, as well as custom sizes, designs and modifications quoted separately.

<u>Replacement Activated Carbons</u>	<u>1-3</u>	<u>4-9</u>	<u>10+</u>
TIGG 5C 0410, 200 lb. net drum	\$ 385	\$ 365	\$ 345
TIGG HSS or HP 0410, 250 lb. net drum	695	675	655

<u>Accessories; all quantities</u>	<u>N100; 150</u>	<u>N250</u>	<u>N500</u>	<u>N1000; 1500</u>	<u>N3000</u>
Fan, EP motor, premounted	\$ 670	\$ 805	\$ 670	\$ 805	Per fan type
Flame arrestor, Al/Al "	400	400	- -	Individually quoted - -	- -
Saturation indicator	40	40	60	60	\$ 60
Weather cover	NA	NA	345	490	680
Accumulator cabinet	"	"	675	945	1890

Notes:

- (a) NIXTOX units are designed for air pollution control and process gas purification. For water and other liquids, ask about TIGG's CANSORB[®] Modular Adsorbents.
- (b) Contains adsorbent loading supplied in 55 gallon unit by others. The standard N100 or N100 XP units are significantly more cost effective.
- (c) N100 is a double epoxy/phenolic lined D.O.T. 5B drum. N100 XP is a crosslinked, high density polyethylene vessel with PVC/CPVC internals, meeting D.O.T. Section 34.

8/31/87



TIGG CORPORATION

BOX 11661
PITTSBURGH, PA 15228

TELEPHONE: (412) 563-4300
TELEX: 269312 (RCA)
CABLE: TIGGCOR PITTSBURGH
MANUFACTURING: TIGG SOUTH CENTRAL OPERATIONS
ROUTE 16 EAST
HEBER SPRINGS, ARKANSAS 72543

9

PRICE SCHEDULE

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<u>Price/Unit</u>	<u>1-3</u>	<u>4-9</u>	<u>10+</u>	<u>Lbs. fill</u>	<u>Type</u>
N 50	\$ 415	405	395	110	Closed - upflow
N 100 VS ^(b)	585	575	560	150	" "
N 100 & N 100 XP ^(c)	665	655	640	200	" "
N 150	1105	1065	1040	300	" "
N 250	1530	1470	1445	400	" "
N 500 DB	6555	6405	6345	1900	" "
N 750 DB	11060	10870	10725	3200	" "
N 1500 DB	17875	17625	17525	5700	" "
N 500	1225	1175	1135	200	Radial
N 1000	2325	2245	2190	400	"
N 1500	2270	2190	2135	300	"
N 3000	7010	6840	6730	1600	"
Boxsorber 6/6	12600	12300	12150	3000	Closed - transverse
Boxsorber 8/8	18815	18300	18050	5300	" "

Special Units:

HSS or HP Adsorbents - All quantities; add \$310 for each 200 lbs. fill given above; e.g. for one N 150; \$1105 + 1.5(\$310) = \$1570. Type HSS is extra selective for hydrogen sulfide and lighter mercaptans, Type HP for ammonia and lighter amines.

Models containing activated aluminas, molecular sieves or other specialized desiccants and adsorbents, as well as custom sizes, designs and modifications quoted separately.

<u>Replacement Activated Carbons</u>	<u>1-3</u>	<u>4-9</u>	<u>10+</u>
TIGG 5C 0410, 200 lb. net drum	\$ 385	\$ 365	\$ 345
TIGG HSS or HP 0410, 250 lb. net drum	695	675	655

<u>Accessories; all quantities</u>	<u>N100; 150</u>	<u>N250</u>	<u>N500</u>	<u>N1000; 1500</u>	<u>N3000</u>
Fan, EP motor, premounted	\$ 670	\$ 805	\$ 670	\$ 805	Per fan type
Flame arrestor, Al/Al "	400	400	- -	Individually quoted	- -
Saturation indicator	40	40	60	60	\$ 60
Weather cover	NA	NA	345	490	680
Accumulator cabinet	"	"	675	945	1890

Notes:

- NIXTOX units are designed for air pollution control and process gas purification. For water and other liquids, ask about TIGG's CANSORB[®] Modular Adsorbers.
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8/31/87



TIGG CORPORATION

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PITTSBURGH, PA 15228

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MANUFACTURING: TIGG SOUTH CENTRAL OPERATIONS
ROUTE 16 EAST
HEBER SPRINGS, ARKANSAS 72543

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 08/17/88

Contacted by: Telephone

Company/Agency: Chemrox, Inc.
217 Long Hill Crossroads
Shelton, Connecticut 06484

Telephone Number:

Person(s) Contacted/Title(s)

Pankajh Desai

RECEIVED

AUG 28 1997	
CONFIRMATION	
OAQPS AIR	
DOCKET CONTROL ROOM	
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input checked="" type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Desai was contacted about the ethylene oxide (EO) removal efficiency of acid-water scrubbers with 12/88 and pure EO. He stated that once the scrubber's operating parameters are set (i.e., tower diameter, packing height, gas and liquid flowrates, and temperature), the absorption rate is dependent on the EO concentration difference between the gas and liquid. As the difference in EO concentration increases, the removal efficiency increases. Mr. Desai said that, during the first evacuation, the EO concentration of the stream entering the scrubber is approximately 20 to 25 percent by volume for 12/88, and about 80 to 85 percent for pure EO. Mr. Desai stated that a scrubber which is achieving an efficiency of 99.0 percent with pure EO or 12/88 might achieve an efficiency less than 99.0 percent with 10/90 (EO/CO₂) in which the scrubber inlet stream would be less than 10 percent EO by volume.

Mr. Desai said that although Chemrox guarantees absolutely an efficiency of 99.0 percent, the DEOXX™ scrubbers are generally designed to achieve an efficiency no less than 99.5 percent so that the efficiency will never decrease below 99.0 percent. If a facility uses mainly pure EO but also infrequently uses 12/88, the scrubbers are designed with an efficiency of at least 99.5 percent with pure EO, and at least 99.0 percent with 12/88. However, Chemrox only guarantees 99.0 percent removal for both gas types.

Mr. Desai said that the DEOXX™ system that was tested by EPA at Burrton Medical was guaranteed to achieve 99.0 percent. The design efficiency was not 99.9 percent. Mr. Desai said that the high efficiency (99.9 percent) measured at the EPA test was probably due to the low ethylene glycol concentration (~20 percent) in the scrubber at the time of testing. Mr. Desai said that to maintain an EO removal efficiency of at least 99.9 percent, the scrubbing liquid might need to be changed more frequently (e.g., at 20 weight percent glycol for 12/88, and 40 percent glycol for pure EO) than normally recommended (i.e., at 60 percent glycol). Mr. Desai stated that the EO removal efficiency could also be increased at a "moderate cost" by increasing the liquid flowrate.

Mr. Desai said that the DEOXX™ scrubber tested at Chesebrough-Pond's is an older design that is no longer manufactured. The Chesebrough system has only a once-through scrubber and no reaction tank, which probably explains the lower efficiency for that unit.

The DEOXX™ system at McCormick is also different from the usual system. McCormick wanted the scrubber located indoors. Therefore, the unit is designed with the reactor wrapped around the tower to save space.

The DEOXX™ system at Burron has two short (16 foot) towers instead of one tall tower because it is located very close to an airport. Mr. Desai said that most new DEOXX™ units have only one tall tower (21 to 30 feet) instead of two short towers and require a total floor space of approximately 300 to 400 square feet. Units located outdoors are designed to protect from freezing.

From: David L. Newton and Sharon Srebro
Environmental Engineering Department

RECEIVED

Date of Contact: 5/9/86 and 10/04/88 (for revisions)

Contacted by: Telephone

Company/Agency: Johnson & Johnson, International
New Brunswick, New Jersey

Telephone Number: (201) 524-2978
Fax (201) 214-0332
214-0334

AUG 24 1997

CONFIRMATION
OAQPS AIR
DOCKET CONTROL ROOM
RESPONSE <i>See attached</i>
<i>Telecon</i>
WRITTEN <input type="checkbox"/>
VERBAL <input checked="" type="checkbox"/>
NONE <input type="checkbox"/>

Person(s) Contacted/Title(s)

Mr. Miron G. Popescu, Technical Advisor

A followup call to confirm the information in the original contact report (see attached) was conducted October 4, 1988, by Sharon Srebro. Mr. Popescu provided verbal revisions that are incorporated in this version of the report. (see also telecon dated October 4, 1988, Sharon Srebro with Miron Popescu.)

CONTACT SUMMARY:

I called Mr. Popescu to discuss EO sterilization processes and EO emissions from sterilization chamber evacuation cycles and aeration cycles.

Mr. Popescu said that one can fairly accurately model EO behavior in an empty sterilization chamber by using ideal gas relationships. For example, if a 600 ft³ chamber is charged with 50 lb of 80/20 EO/CO₂ mix at an operating pressure of 0.9 atm, the EO concentration would be approximately 1,000 mg/l. If the chamber is evacuated to 1 in. Hg absolute (or 0.03 atm absolute), approximately 0.81 lb of sterilant gas are left in the chamber, or approximately 49 lb of sterilant gas are removed.

I asked Mr. Popescu how such a calculation would compare with actual data. Mr. Popescu responded that measurement data were available, and that typically one would measure concentrations of 600,000 to 700,000 ppmv at about 6 in. from the stack exit during the first evacuation cycle.

Mr. Popescu said that the common practice of vacuum pulsing (pulsating purge) only serves to remove EO adsorbed on the chamber walls, but does not remove EO absorbed in the product to any significant extent. He said that this practice helps to lower worker exposure to EO when the chamber doors are opened and products unloaded. He said that vacuum pulsing would remove perhaps another 10 percent of the remaining 0.81 lb in the hypothetical case discussed earlier. This would result in maximum stack concentrations of 3,000 to 4,000 ppmv.

Mr. Popescu said that a 3 to 7 day aeration period is typical for products after they have been removed from the sterilization chamber. During aeration, products may be exposed to heat and airflow, but according to Mr. Popescu, time is the essential element for removing absorbed EO from the product. He said that FDA requires that EO concentrations in most products be no higher than 250 ppmw. Certain surgical implants may require lower concentrations. Mr. Popescu said that roughly 80 percent of the material originally absorbed by the product is desorbed within 7 days.

Mr. Popescu said that a good contact for information on absorption of EO and EO chemistry during sterilization processes is Mr. Ed Gunsales at the Johnson & Johnson plant in Valley Forge, Pennsylvania. He can be reached at (215) 337-2400.

CONTACT REPORT--MRI Project No. 7712-K

From: David L. Newton, Environmental Engineering Department
Date of Contact: 5/9/86
Contacted by: Telephone
Company/Agency: Johnson & Johnson, International
New Brunswick, New Jersey
Telephone Number: (201) 524-5483

Person(s) Contacted/Title(s)

Mr. Miron G. Popescu, Technical Advisor

CONTACT SUMMARY:

I called Mr. Popescu to discuss EO sterilization processes and EO emissions from sterilization chamber evacuation cycles and aeration cycles.

Mr. Popescu said that one can fairly accurately model EO behavior in the sterilization chamber by using ideal gas relationships. For example, if a 600 ft³ chamber is charged with 50 lb of 80/20 EO/CO₂ mix at an operating pressure of 0.9 atm, the EO concentration would be approximately 1,000 mg/l. If the chamber is evacuated to 1 in. Hg absolute (or 0.03 atm absolute), approximately 1.81 lb of sterilant gas are left in the chamber, or approximately 48 lb of sterilant gas are removed.

I asked Mr. Popescu how such a calculation would compare with actual data. Mr. Popescu responded that measurement data were available, and that typically one would measure concentrations of 600,000 to 700,000 ppmV at about 6 in. from the stack exit during the first evacuation cycle.

Mr. Popescu said that the common practice of vacuum pulsing (pulsating purge) only serves to remove EO adsorbed on the chamber walls, but does not remove EO absorbed in the product to any significant extent. He said that this practice helps to lower worker exposure to EO when the chamber doors are opened and products unloaded. He said that vacuum pulsing would remove perhaps another 10 percent of the remaining 1.81 lb in the hypothetical case discussed earlier. This would result in maximum stack concentrations of 3,000 to 4,000 ppmV.

Mr. Popescu said that a 3 to 7 day aeration period is typical for products after they have been removed from the sterilization chamber. During aeration, products may be exposed to heat and air flow, but according to Mr. Popescu, time is the essential element for removing absorbed EO from the product. He said that FDA requires that EO concentrations in products be no higher than 250 ppmV. Mr. Popescu said that roughly 80 percent of the material originally absorbed by the product is desorbed within 7 days.

Mr. Popescu said that a good contact for information on absorption of EO and EO chemistry during sterilization processes is Mr. Ed Gunsales at the Johnson & Johnson plant in Valley Forge, Pennsylvania. He can be reached at (215) 337-2400.

FILE COPY

CONTACT REPORT--MRI Project No. 7723

4-88-03

From: Sharon Srebro, Environmental Engineering Department

E 315

Date of Contact: 10/04/88

RECEIVED

Contacted by: Telephone

Company/Agency: Johnson & Johnson International
1 J&J Plaza
New Brunswick, New Jersey 08933

Telephone Number: (201) 524-2978

Person(s) Contacted/Title(s)

Mr. Miron G. Popescu

CONFIRMATION	1997
11/16/88	
OAGPS AIR	
DOCKET CONTROL ROOM	
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input checked="" type="checkbox"/>	

CONTACT SUMMARY:

I contacted Mr. Popescu concerning two issues: (1) whether Damas acid-water scrubbers are capable of achieving 99.9 percent EO removal and (2) whether his conversation with David Newton in May 1986 (see attached) was interpreted by him as a discussion of residual EO levels before aeration.

Scrubber efficiency--Mr. Popescu was asked (1) whether a Damas scrubber is capable of achieving 99.9 percent EO removal and (2) if there are test data available for the efficiency of the scrubber with pure EO. Mr. Popescu stated that Damas scrubbers are used at the Johnson & Johnson facilities in New Brunswick, New Jersey, and Sherman, Texas, and at the Ethicon facilities in Canada and Somerville, New Jersey. He said that efficiency testing with pure EO had been conducted at one of the New Jersey plants. However, he does not want to release the data for the following reasons. Mr. Popescu said that he believes that an efficiency of 99.9 percent cannot be proven for any scrubber because of limitations in the sampling methods, testing equipment, and analytical procedure. He believes that the stated efficiency should not be based on one test but, instead, on the average efficiency over a 1-year period. Mr. Popescu said that if the results of one test indicate an efficiency of 99 percent but over the course of a year, the scrubber is shutdown half of the time due to maintenance, the efficiency should be reported as only 50 percent. Mr. Popescu said that he believes the removal efficiencies of most scrubbers are in the 97 to 99 percent range, but, due to limitations in analytical procedures, the actual efficiency (i.e., how much greater than 97 percent) cannot be accurately determined. Therefore, efficiencies should be reported simply as greater than 97 percent.

Aeration room residuals--Mr. Popescu was questioned about the attached contact report with David Newton of MRI. He was asked whether that conversation, in his opinion, was a discussion about EO residuals in products prior to aeration. Mr. Popescu stated that the information he supplied was not related to EO residuals before aeration. However, information in paragraph 5 of the report does refer to EO residuals after aeration. He made verbal revisions to the contact report. In paragraph 2 of the contact report, Mr. Popescu stated that the information refers to an empty chamber, not one

with products enclosed. He said that the amount of sterilant gas remaining in the chamber would be approximately 0.81 pounds (see paragraphs 2 and 4), instead of the 1.81 pounds reported. He also said that the FDA limit for EO residuals after aeration may be less than ~~7~~²50 ppmw for certain surgical implants (see paragraph 5).

Mr. Popescu said that he assumed that possibly 3 to 5 percent of the initial EO charge could be trapped in the product before aeration in the form of glycol (2 percent of charge) or trapped liquid residual EO. However, Mr. Popescu believed that most of this residual EO is trapped and will not offgas. The amount of residual EO is product dependent and varies.

CONTACT REPORT--MRI Project No. 7712-K

From: David L. Newton, Environmental Engineering Department
Date of Contact: 5/9/86
Contacted by: Telephone
Company/Agency: Johnson & Johnson, International
New Brunswick, New Jersey
Telephone Number: (201) 524-5483

Person(s) Contacted/Title(s)

Mr. Miron G. Popescu, Technical Advisor

CONTACT SUMMARY:

I called Mr. Popescu to discuss EO sterilization processes and EO emissions from sterilization chamber evacuation cycles and aeration cycles.

Mr. Popescu said that one can fairly accurately model EO behavior in the sterilization chamber by using ideal gas relationships. For example, if a 600 ft³ chamber is charged with 50 lb of 80/20 EO/CO₂ mix at an operating pressure of 0.9 atm, the EO concentration would be approximately 1,000 mg/l. If the chamber is evacuated to 1 in. Hg absolute (or 0.03 atm absolute), approximately 1.81 lb of sterilant gas are left in the chamber, or approximately 48 lb of sterilant gas are removed.

I asked Mr. Popescu how such a calculation would compare with actual data. Mr. Popescu responded that measurement data were available, and that typically one would measure concentrations of 600,000 to 700,000 ppmV at about 6 in. from the stack exit during the first evacuation cycle.

Mr. Popescu said that the common practice of vacuum pulsing (pulsating purge) only serves to remove EO adsorbed on the chamber walls, but does not remove EO absorbed in the product to any significant extent. He said that this practice helps to lower worker exposure to EO when the chamber doors are opened and products unloaded. He said that vacuum pulsing would remove perhaps another 10 percent of the remaining 1.81 lb in the hypothetical case discussed earlier. This would result in maximum stack concentrations of 3,000 to 4,000 ppmV.

Mr. Popescu said that a 3 to 7 day aeration period is typical for products after they have been removed from the sterilization chamber. During aeration, products may be exposed to heat and air flow, but according to Mr. Popescu, time is the essential element for removing absorbed EO from the product. He said that FDA requires that EO concentrations in products be no higher than 250 ppmV. Mr. Popescu said that roughly 80 percent of the material originally absorbed by the product is desorbed within 7 days.

Mr. Popescu said that a good contact for information on absorption of EO and EO chemistry during sterilization processes is Mr. Ed Gunsales at the Johnson & Johnson plant in Valley Forge, Pennsylvania. He can be reached at (215) 337-2400.

From: Brenda Shine, Environmental Engineering Department

Date of Contact: October 19, 1988

Contacted by: Telephone

Company/Agency: Donaldson Company
Post Office Box 1299
1400 West 94th Street
Minneapolis, Minnesota 55440

Telephone Number: (612) 887-3710

Person(s) Contacted/Title(s)

Mr. Cary Olson

RECEIVED

AUG 23 1997	
CONFIRMATION sent 11/09/88	OAQPS AIR
DOCKET CONTROL ROOM	
RESPONSE See attached	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Olson was contacted for information on the EtO Abator™ catalytic oxidation system and its applicability to controlling ethylene oxide (EO) emissions from large aeration rooms. The questions asked, and his responses, are presented below.

1. Question. How large is the aeration room at American Pharmaseal (American Medical Packaging)?

Answer. This is a laboratory-scale room (small). The facility has since been bought out by Baxter Healthcare, and the devices are no longer in operation.

2. Question. The Seamless Company seals its aeration room and routes the exhaust from the control device back to the room. Does Donaldson recommend this--why or why not?

Answer. The measure is a recommended practice and is done to reduce energy costs of preheating the aeration room gas before it enters the control device.

3. Question. Are you aware of any facilities other than Seamless that use an EtO Abator™ for aeration rooms that are greater than 5,000 ft³ in volume?

Answer. No.

4. Question. Could you use an EtO Abator™ for an aeration room having an exhaust rate of 40,000 scfm (corresponds to an aeration room of greater than 100,000 ft³) and an EO concentration of 1 to 5 ppmv?

Answer. Donaldson has units designed to handle flow rates up to 12,000 scfm. For higher exhaust rates, multiple units could be used; however, other control devices such as carbon adsorbers might be more effective in controlling large aeration rooms with low concentrations of EO (<10 ppm).

5. Question. Would the multiple units be capable of achieving 99 percent or better control for a large aeration room such as the one mentioned above? Are test data available for control of large aeration rooms with low EO concentrations?

Answer. The problem with controlling EO emissions from sources such as large aeration rooms is that the concentration of EO is so low at the inlet to the control device (<10 ppm) that it is virtually impossible to verify removal efficiencies because of the detection capabilities of the measuring instruments. Mr. Olson stated that as long as the unit is running and the concentration of EO in the inlet stream is between 10 and 5,000 ppmv, test data indicate that the EtO Abator™ will achieve better than 99.9 percent control. Test data are not available for concentrations less than 10 ppmv because of the above mentioned analytical problems.

6. Question. The contact report with Rebecca Nicholson of this office reported prices for EtO Abators™ to control both sterilizers and aeration. The reports stated that the cost for a unit to control aeration only would be lower. How much lower?

Answer. The cost is lower because you don't have to deal with the instrumentation and controls on the sterilizer. Though the reduction in price is significant, it isn't half the price of controlling both.

7. Question. Do you have information on the approximate cost of installation and ductwork for an EtO Abator™ at a large aeration room? Are the costs comparable to standard industry costs of installation and ductwork?

Answer. Yes, ductwork and installation costs are comparable to standard heating and installation costs.

8. Question. Do you have any estimates of annual operating costs for aeration rooms, specifically, large aeration rooms?

Answer. A 6,000 ft³/min exhaust rate requires 2,760 kWh for a 24-hour period. This includes power for the fan and the preheater.



December 12, 1988

RECEIVED DEC 19 1988

Ms. Brenda Shine
Chemical Engineer
Midwest Research Institute
Suite 350
401 Harrison Oaks Boulevard
Cary, N.C. 27513

Dear Ms. Shine:

In reference to your letter covering our conversation on October 19, 1988, please find below our comments.

Question 2: The measure is a recommended practice only if the aeration room is monitored to insure safe levels of ETO. This is to include all safety measures to limit worker exposure. The recirculation was done to reduce energy costs of preheating the aeration room gas before it enters the control device and also heat the aeration room to decrease the time necessary for complete product aeration.

Question 4: Energy costs can be reduced if the waste heat is dumped back into the off-gassing room. We would prefer to do this through double heat exchangers so there is no possibility of ETO re-entering the room.

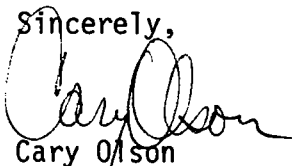
Question 5: To effectively control the large aeration rooms, the cost of energy could be excessive.

Question 7: Ductwork and equipment needs to be able to withstand temperatures of 140-160°F and should be sealed to avoid any leaks.

Question 8: Energy consumption would be less if aeration room reaches temperature equilibrium. This is dependent on room temperature and design.

Should you have any further questions, please contact me.

Sincerely,



Cary Olson

CO:pw

RECEIVED

AUG 28 1997

From: Beth Friedman and Sharon Srebro
Environmental Engineering Department

Date of Contact: 8/25/88 and 10/20/88

Contacted by: Telephone

Company/Agency: Bay Area Air Quality
Management District

Telephone Number: (415) 771-6000, ext. 328

Person(s) Contacted/Title(s)

Tim Smith

COMM. OAGPS AIR Sent 10/26/88
DOCKET CONTROL ROOM
RESPONSE Received Nov 4, 1988
Changes incorporated
WRITTEN <input checked="" type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>

CONTACT SUMMARY:

Mr. Smith called to see if we could provide some technical information on ethylene oxide (EO) commercial sterilizers. He asked the following questions:

1. He is in the process of developing modeling inputs for the condenser at Barnes Hind. He wanted to know if we knew of any work done to estimate the equilibrium capacity of EO at a given temperature. In general, how is condenser efficiency determined?

2. The background information document (BID) says that recirculating pumps cost \$5,000. Mr. Smith was told by Safeway (a sterilizer in the District) that their oil-sealed pump, which was purchased from Chemrox, cost \$25,000. Do we have any explanation for the discrepancy? Safeway also thought that our estimate of 5 percent of emissions from aeration rooms was high.

3. The scrubber costs used in the BID are based on Damas costs. Is there a reason we did not use Chemrox?

Mr. Smith and I also discussed the District's EO users and regulatory development program. Mr. Smith said that there are currently four EO users in the District. There are two spice sterilizers. Safeway in Fremont has a Chemrox system with oil-sealed pump. Presco Foods, in South San Francisco, has a 200 cubic foot chamber and uses approximately 200 lb/yr of EO in a 12/88 mixture. There are two medical equipment suppliers. Barnes Hind uses a condenser and Ways and Means in San Rafael is uncontrolled. Two Gentry Food facilities (formerly Gilroy Foods) that may be in our data base no longer use EO sterilization; they use a chlorination process (i.e., ClO₂) instead.

Mr. Smith said that the Bay Area District's pharmaceutical product rule (Regulation 8, Rule 24) requires control of sterilizers at pharmaceutical plants, which is why Barnes Hind is controlled. (This rule requires 75 percent emission reduction of VOC's from new and existing pharmaceutical plants. The rule became effective July 1, 1984.) Although EO is now listed as a toxic air contaminant under AB-1807, there is a dispute over which Agency has jurisdiction to regulate. Nonetheless, the District is developing refined

modeling information and cost data at present. The District has recently sent letters to hospitals requiring them to permit their sterilizers. Mr. Smith said it is possible that hospital sterilizers will be controlled in the future along with commercial sterilizers.

We discussed the status of the EO regulation and of the CFC regulation. Mr. Smith was interested in learning more about the CFC control alternatives.

ACTION ITEMS:

Have Sharon Srebro call Mr. Smith to respond to his questions and followup on the status of the District's program.

A followup call by Sharon Srebro was conducted October 20, 1988. Because there are demonstrated control technologies for sterilization vent emissions currently available, Mr. Smith said that the District may regulate EO emissions from sterilizers and exempt emissions from aeration rooms. However, the District will continue to examine control techniques for aeration room emissions.

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 10/20/88

Contacted by: Telephone

Company/Agency: Seamless Hospital Products
1909 N.E. 25th Avenue
Ocala, Florida 32670

RECEIVED

AUG 23 1997

Telephone Number: (904) 732-0600

OAGPS AIR
DOCKET CONTROL ROOMPerson(s) Contacted/Title(s)

Lee Cutright, Director of Quality Assurance

CONTACT SUMMARY:

Mr. Cutright was contacted for information on the EtO Abator™ catalytic oxidation systems used to control ethylene oxide (EO) emissions from aeration rooms at the Seamless facilities in Ocala, Florida, and El Paso, Texas. The questions, and his responses, are presented below.

1. What was the installation cost of the incinerators? Mr. Cutright did not know offhand, but would check and get back to me.

2. What was the concentration of EO in the aeration room before the incinerators were installed? The company never tested the aeration room EtO concentration.

3. Were the controls installed to control aeration room emissions to the atmosphere or to decrease indoor EO concentration? Both; also, the company is trying to reduce the amount of EO remaining in the product.

4. What are approximate annual operating costs of the units? Mr. Cutright would check and get back to me.

5. Are there any operating problems with the units? No, other than the fact that the units may be oversized.

6. Why is makeup air allowed to enter the aeration room? To control the temperature of the room, which is maintained at 120°F. (Incinerator exhaust is assumed to be 250° to 300°F, therefore makeup air is needed).

CONFIRMATION	Sent 11/05/88
RESPONSE	
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/1/88

Contacted by: Telephone

Company/Agency: Johnson and Johnson Patient Care
US 75 South at FM 1417
Post Office Box 5000
Sherman, Texas 75090

Telephone Number: (214) 868-9212

Person(s) Contacted/Title(s)

D. C. Williams, Safety Manager

RECEIVED
AUG 2 1997
CROSS REF
CONFIRMATION Dec 8, 1988
RESPONSE
WRITTEN ☒
VERBAL ☐
NONE ☐

CONTACT SUMMARY:

Mr. Williams was contacted for clarification of his response to the July 1988, EPA information request. Specifically, in Part V of the response, the size of the aeration room and the ventilation rate did not agree with the reported number of air changes per hour. Mr. Williams stated that the number of air changes per hour and the ventilation rate were estimates; there is no real designed air change in the warehouse, other than what is achieved through normal building ventilation.

Mr. Williams provided this further explanation on the entire sterilization process. Products are sterilized on pallets in a 4-pallet sterilizer module. After the sterilization cycle is complete, the pallets are taken out of the sterilizer and allowed to "degas" in a ventilated degassing area equipped with a hood. The EtO concentration in the degassing area is about 7 ppm. Degassing time varies between 15 minutes and 2 hours. Specific information on the degassing area was reported in Part V-A of the questionnaire response. After degassing, the pallets are taken to a warehouse, where they may sit for a week before being transferred to an adjacent storage area for sales distribution.

Mr. Williams added that his company employs industrial hygienists to periodically monitor the EtO concentration in the degassing and warehouse areas and stated that typical EtO concentrations in the warehouse are on the order of 0.1 to 0.3 ppm, whereas the EtO concentration in the degassing area is approximately 7 to 8 ppm.

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/1/88

Contacted by: Telephone

Company/Agency: Morris J. Golombeck, Inc.
960 Franklin Avenue
Brooklyn, New York 11225

Telephone Number: (718) 284-3505

Person(s) Contacted/Title(s)

Shelly Golombeck

RECEIVED

AUG 2 1987

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT SUMMARY:

Golombeck, Inc., was contacted for clarification of the response to Part V of the July 1988, EPA information collection request. Specifically, the number of air changes/hour was listed as two for the aeration process, even though aeration of the product is carried out on an open loading dock. Mr. Shelly Golombeck provided a further explanation of the process:

Sterilization is carried out in a chamber. After the sterilant gas mixture has contacted the product for the desired amount of time, the gas is evacuated from the chamber. Mr. Golombeck stated that the chamber is evacuated twice and that it takes approximately $\frac{1}{2}$ hour for a complete air change of the chamber. The number of air changes/h reported on the questionnaire response refers to the number of evacuation/air wash cycles for each sterilization cycle. After the second air wash of the chamber, the chamber door is left open for a minimum of 1 hour before the spices are brought out of the chamber and placed on the loading dock. The product remains on the loading dock at least 24 hours before it is shipped.

CONFIRMATION <u>sent 11/5/88</u>
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/2/88

Contacted by: Telephone

Company/Agency: Seamless Hospital Products
1909 N.E. 25th Avenue
Ocala, Florida 32670

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (904) 732-0600

Person(s) Contacted/Title(s)

Lee Cutright, Director of Quality Assurance

CONTACT SUMMARY:

Mr. Cutright was contacted for followup information regarding his company's most recent submittal of the Section 114 information request EtO emissions from commercial sterilization operations. Specifically, the company reported four operational chambers at the Ocala facility on the 1986 questionnaire but only three operational chambers in the 1988 questionnaire. Mr. Cutright verified the fact that chamber No. 4 has been out of operation since 1985 due to problems with the automatic doors. He stated that the company would like to put the chamber back in operation, but that they are having problems obtaining space ports. Mr. Cutright also stated that he was gathering cost information of purchased and installation costs and annualized costs of employing the EtO Abator™ at Seamless facilities in Ocala, Florida, and El Paso, Texas, and would forward it to me.

CONFIRMATION <i>sent 12/05/88</i>
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

CONTACT REPORT--MRI Project No. 7723

II E 322

RECEIVED

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 11/08/88

AUG 26 1997

Contacted by: Telephone

OAQPS AIR
DOCKET CONTROL ROOMCompany/Agency: U.S. EPA
Environmental Research Center
Room C-114
Research Triangle Park, N.C. 27711

CONFIRMATION

RESPONSE 8/28/88

Telephone Number: 541-2848

Person(s) Contacted/Title(s)

John Margeson

WRITTEN ☒
VERBAL ☐
NONE ☐

CONTACT SUMMARY:

Mr. Margeson was contacted regarding the lower limit of detection for EO by GC analysis. He stated that at the July 1988, EPA-sponsored test of scrubber efficiency, the lowest concentration measured by any column (a 3 percent SP-1000) was 0.06 ppmv. The column that gave the best separation of EO from CFC-12 was a 1 percent SP-1000 and had a lower detection limit of 0.16 ppmv. Mr. Margeson stated that grab sampling followed by off-line GC analysis with one of these columns would probably be applicable to testing the efficiency of an aeration room control device. He stated that the high temperature (120°C) of the gas exiting a catalytic oxidizer would be no problem because the GC could handle cooling the gas to the column temperature. The optimal column temperature was 45° to 60°C.

Mr. Margeson stated that an alternative analytical method may be applicable to measuring the low concentrations of EO exiting aeration room control devices. The procedure involves the reaction of EO with hydrogen bromide to produce 2-bromoethanol, which is then analyzed by gas-liquid chromatography using an electron capture detector. He stated that OSHA is using this method in monitoring worker exposure. The electron capture detector is more sensitive than a flame ionization detector and can detect EO weights as low as the picogram (10^{-12} gram) range. The reaction product, 2-bromoethanol, is toxic and poisonous (LD_{50} is <50 mg/kg) but can be handled safely in a proper laboratory environment. Mr. Margeson suggested that I refer to "Analytical Chemistry," Vol. 56, pp. 1950-53 (1984) for a description of this process.

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/9/88

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Seamless Hospital Products
1909 N.E. 25th Avenue
Ocala, Florida 32670OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (904) 732-0600

Person(s) Contacted/Title(s)

Lee Cutright, Director Quality Assurance

CONTACT SUMMARY:

Mr. Cutright called me back to provide information on the costs of the catalytic oxidation units that are used to control E0 emissions from aeration rooms at the Seamless facilities in Ocala, Florida, and El Paso, Texas.

Total installed capital costs for the units were \$262,000 for the Ocala, Florida, facility and \$230,000 for the El Paso, Texas, facility. These costs include the catalytic oxidation units, auxiliary equipment, plumbing, and installation. The units were installed in 1985 and costs are in 1985 dollars. Annualized operating costs may be calculated using the following information:

The manufacturer claims that the cells last 3 years. Each unit contains eight cells, and there are two units at each plant. Replacement costs of the cells are \$1,250/cell. Based on this information, Mr. Cutright estimated that it costs each plant \$20,000 every 3 years to maintain the units. Mr. Cutright did not mention any costs associated with preheating the inlet air to the control device.

CONFIRMATION	sent 12/05/88
RESPONSE	
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/11/88

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: DAVOL, Inc.
Post Office Box 8500
Cranston, Rhode Island 02920

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (401) 463-7000

Person(s) Contacted/Title(s)

Joseph M. Mello, Manager of Laboratory Function

OK *Joseph M. Mello* *12/2/88*

CONTACT SUMMARY:

Mr. Mello returned my call to Davol in which I had questioned some information submitted by the facility in the most recent Section 114 information request. Specifically, in Part V of the request, the number of air changes per hour (20) did not correspond with the ventilation rate during aeration (1,200 ft³/h) and the size of the aeration room (1,045 ft³). I wanted to know which pieces of information were correct, since the ventilation rate divided by the aeration room size should equal the number of air changes in a certain time period.

Mr. Mello called back to clarify the situation for me. The exhaust rate out of the aeration room is actually 350 ft³/min, which corresponds to 20 air changes/h for an aeration room of 1,045 ft³. The ventilation rate inside the aeration room is actually 700 ft³/min, but 50 percent of this flow is recirculated through the use of dampers so that only 50 percent of the flow (350 ft³/min) is actually exhausted out of the aeration room.

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/18/88

RECEIVED

Contacted by: Telephone

AUG 2 1997

Company/Agency: Durkee-French Foods
1001 8th Avenue
Bethlehem, Pennsylvania 18018

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (215) 867-0521

Person(s) Contacted/Title(s)

Ray Shucker, Chemist

CONTACT SUMMARY:

I contacted the plant to find out on which dates that the sterilizer is shutdown during the year. The company's response to the recent Section 114 information request stated that the sterilizer was shutdown the entire month of July in 1985. Mr. Shucker stated that the plant closed each year during the week of July 4, during which time the sterilizer is also shutdown. He knew of no other annual planned shutdowns of the sterilizer.

CONFIRMATION Sent 12/25/88
RESPONSE
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

A-88-03

II E 326

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/18/88

Contacted by: Telephone

Company/Agency: Michigan Science and Engineering
Post Office Box 7105
Ann Arbor, Michigan 48107**RECEIVED**

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (313) 994-0280

Person(s) Contacted/Title(s)

David Hammer, Consulting Chemical Engineer

CONTACT SUMMARY:

Mr. Hammer returned my call to Mr. Richard Kruse of Advanced Air Technologies, maker of the "Safe Cell"™ EtO control device. I had contacted Mr. Kruse to inquire about the capital and annualized costs of installing Safe Cell™ units to control large, warehouse-type aeration rooms. Mr. Hammer, consultant to Mr. Kruse, returned my call and was willing to provide cost estimates if I could specify aeration parameters, such as the size of the warehouse, the flow rate of the gas routed to the control device and typical EtO concentrations. After consulting with Sharon Srebro, project leader, we decided that we would contact Mr. Hammer with those specific parameters when a decision was made by the project team about what parameters are representative of the industry.

CONFIRMATION sent 12/25/88
RESPONSE
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 11/21/88

Contacted by: Telephone

Company/Agency: Abbott Laboratories
Building AP-1, Routes 43 and 137
Abbott Park, Illinois 60064

RECEIVED

AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOM

Telephone Number: (312) 937-7416

Person(s) Contacted/Title(s)

Larry Hecker, Director of Corp. Ind. Hygiene

CONTACT SUMMARY:

Mr. Hecker was contacted to provide some clarification of the information submitted in Part V of the most recent Section 114 information request concerning emissions of EtO. Specifically, the aeration room was reported to be a cabinet that no longer exists. Mr. Hecker stated during our conversation that the (12 ft³) sterilizer chamber for facility No. 6 is not used anymore, but that when it was used, the sterilized products were put in an enclosed box about the size of a file cabinet for aeration. The cabinet ventilation rate of 1,000 ft³/min as stated in the questionnaire is an estimate, as it was never actually measured. Mr. Hecker stated that the sterilization operation at this facility was laboratory-scale.

CONFIRMATION <u>sent 12/05/88</u>
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>

RECEIVED MAY 23 1989

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 12/09/88

Contacted by: Telephone

Company/Agency: DM3, Incorporated
1530 E. Edinger Avenue
Suite 5
Santa Ana, California 92705

RECEIVED

AUG 2 1997

OAGPS AIR UNIT
DOCKET CONTROL ROOM

Sent 5/16/89

Received May 23, 1989

Telephone Number: (714) 543-1312

Person(s) Contacted/Title(s)

Dominic Meo, President

CONTACT SUMMARY:

I. The DM3 CATCON System

Mr. Meo stated that the CATCON system developed by DM3 Incorporated is similar to, but differs internally and externally from, the Donaldson EtO Abator™ that was previously sold by Mine Safety appliances (MSA). Both devices are catalytic oxidation systems that use hopcalite catalyst (a coprecipitate of manganese dioxide and cuprous oxide). However, the DM3 system uses extra catalyst to absorb the heat of combustion for EO; the EtO Abator™ requires excess air to control the operating temperature.

Mr. Meo also said that Pharmacia Intermedics Ophthalmic in Southern California is installing a CATCON system in February 1989 to control a 60 ft³ sterilization chamber and five 50 ft³ aeration chambers. He said that DM3 also has several hospitals as clients for the CATCON system. According to Mr. Meo, a CATCON unit for an 8.8 ft³ hospital sterilizer costs about \$25,000; a unit for a 30 ft³ sterilizer costs about \$40,000.

II. Alternative Aeration Technologies

Mr. Meo stated that several facilities are considering alternative techniques to the traditional warehouse-type aeration rooms in order to comply with emission limits or to decrease aeration time. One of the technologies he mentioned was "aeration tunnels," sheet-metal enclosures in which the sterilized products are aerated. To limit worker exposure to EO, the products could be sent by conveyor belt from the sterilization chamber to the aeration tunnel. The tunnels are heated to increase the EO diffusion rate out of the product. The emissions from the tunnels can be controlled more easily than emissions from a large warehouse, and if the control device is incineration, heat from the control unit can be used to heat the tunnel. According to Mr. Meo, the majority (75 to 80 percent) of the residual EO in products off-gases in the first 8 hours of aeration in the heated tunnel. If the aeration tunnel is then required for another load, products in the tunnel could then be moved to a traditional aeration room to complete the aeration process. Even if the emissions from the regular aeration room were not controlled, control

devices on the tunnels would eliminate the majority of aeration emissions. Mr. Meo said that he had recommended that Botanicals International in Long Beach, California, and Sterilization Services of Memphis, Tennessee, install aeration tunnels. Botanicals has two 2,000 ft³ sterilization chambers. The facility sterilizes two loads per day and, therefore, would need two 2,000 ft³ chambers for aeration.

May 19, 1989

Dear Sharon,

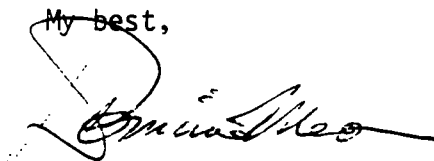
Regarding the information in Paragraph I. above, DM3 has developed two types of emission-control devices for controlling ethylene-oxide emissions. One, as you point out uses excess catalyst to absorb the heat of oxidation of the gas vented from the gas sterilizer at the end of the sterilization cycle. Heat stored in the catalyst is given up during treatment of the gases released during the air-wash cycles.

The other DM3 system uses dilution air, just as the Donaldson system does. There are differences between DM3 and Donaldson systems which use dilution air, in the amount of catalyst used, the type of heat-recovery exchanger, the instrumentation, and the arrangement of the items. Additionally, DM3 uses catalyst made by both the Callery Chemical Division of MSA in Pittsburgh, Pennsylvania, and by Carus Chemical Company in La Salle, Illinois.

Finally, Botanicals International has one 4,000 cubic foot gas sterilizer, not two 2,000 cubic foot units.

The above changes should be made to your contact report. When this is done, the report should be accurate and nonconfidential.

My best,

A handwritten signature in dark ink, appearing to read "Dominic Meo", with a stylized flourish at the end.

Dominic Meo, III
President

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 1/11/89

Contacted by: Telephone

Company/Agency: DM3, Incorporated
1530 E. Edinger Avenue, Suite 5
Santa Ana, California 92705

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (714) 973-1543

Person(s) Contacted/Title(s)

Dominic Meo, President

CONTACT SUMMARY:

Mr. Meo was contacted to obtain information about sterilization process information at Iolab's facility. He said Iolab's aeration room was actually a walk-in refrigerator with a perforated ceiling (made of sheet metal) that was manufactured by Pacific Cooler. The air in the aeration room is circulated down from the ceiling and up through false walls. He said this is different from larger warehouse aeration rooms that move air through the aisles and above the product.

Mr. Meo said that in general an aeration room can be filled from 50-75 percent of capacity. He said air space is necessary for proper aeration (to obtain optimum air circulation) and natural air gaps can be created by stacking the product on pallets in the aeration room. Even though air circulation (and hence product spacing) is important to proper aeration, Mr. Meo stated that temperature is the most important parameter to the aeration process. For this reason he said that the aeration temperature should be increased if the product can tolerate it.

Mr. Meo was also asked about the percent capacity that is generally utilized for most sterilization cycles. He said that most companies fill their sterilizers to 85 percent of capacity.

CONTACT REPORT--MRI Project No. 7723

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 1/13/89

Contacted by: Telephone

Company/Agency: DM3, Incorporated
1530 E. Edinger Avenue
Santa Ana, California 92705

Telephone Number: (714) 543-1312

Person(s) Contacted/Title(s)

Dominic Meo, President

RECEIVED

AUG 23 1997

CONFIRMATION
OADPS AIR
DOCKET CONTROL ROOM
RESPONSE
WRITTEN <input checked="" type="checkbox"/>
VERBAL <input checked="" type="checkbox"/>
INDEXED

CONTACT SUMMARY:

Mr. Meo discussed the two basic types of catalytic oxidizers manufactured by DM3, Incorporated. He also provided information about the use of heated aeration cells.

I. CATCON Catalytic Oxizers

Mr. Meo said that DM3, Inc., offers two types of catalytic oxidizers: one is based on excess air and the other is based on excess catalyst.

A. Excess-Air Design

This design is based on the use of large amounts of diluent air to absorb the heat of reaction and, thus, regulate the temperature of the catalyst bed. The minimum and maximum operating temperatures of the catalyst are 150°C (300°F) and 400°C (750°F), respectively. However, if 12/88 (EO/CFC-12) is used, the aeration temperature should be maintained below 260°C (500°F) to prevent potential thermal decomposition of the CFC.

370 Mr. Meo said that if 12/88 gas is used, 100 ft³ of diluent air must be added to every ft³/min of gas discharged from the vacuum pump. If 100 percent EO is used, 160 ft³/min of diluent air is required for every ft³/min of vacuum pump discharge. The maximum allowable operating temperature of the catalytic oxidizer is higher for pure EO (750°F) than for 12/88 (500°F). However, more diluent is required for pure EO than for 12/88 because the EO in 12/88 is already diluted with CFC. (The 12/88 [weight percent] mixture is 27/73 [volume percent].)

Mr. Meo said that the CATCON unit that is planned for installation at Pharmacia Intermedics Ophthalmic in Southern California is the excess-air design. The system planned is a CATCON 550, which has a design flowrate capacity of 550 standard ft³/min. Because the facility uses 12/88 gas, 100 ft³/min of diluent air must be added to every ft³/min of vacuum pump discharge. Therefore, the flowrate from the vacuum pump cannot exceed 5.5 standard ft³/min. Pharmacia plans to use air from the aeration chambers as part of the diluent; the remainder will be from air inside the building.

Pharmacia has AMSCO Medallion aeration chambers, an older line of chambers that used relays. This line has been replaced by the Eagle series, which uses microprocessors. The facility has a Getinge sterilization chamber. Getinge, a Swedish company, has a plant in Lakewood, New Jersey. A contact at Getinge is Omar Hanfen (phone [201] 370-8800).

B. Excess-Catalyst Design

This design is based on the use of excess catalyst to absorb the heat of the reaction and, thus, regulate the temperature of the catalyst bed. The minimum and maximum operating temperatures are a function of the catalyst and are the same as described in Section 1.A above. As stated previously, if 12/88 gas is used, the catalyst temperature should be kept below 260°C (500°F).

This system requires no diluent air. The gas from the vacuum pump can be sent directly to the control device. As sterilizer volume increases, the amount of EO discharged increases, which increases the catalyst temperature. Therefore, the amount of excess catalyst required to absorb this extra heat and to regulate the temperature increases. A point is reached where it is not cost effective to use excess catalyst to control the catalytic oxidizer temperature, and an excess-air system can be used instead. Therefore, for economic reasons, the use of this design has been limited, thusfar, to smaller sterilizers (<50 ft³). However, because of the lower EO concentrations from aeration processes, the excess catalyst design may be applicable to aeration rooms much larger in volume than the sterilizer volumes used so far.

Mr. Meo said that the CATCON systems used at Riverside Community Hospital and Centinela Hospital are the excess-catalyst design. Riverside has a 24 ft Castle sterilizer. Centinela has a 42 ft ARS Enterprises sterilizer.

II. Heated Aeration Cells

Mr. Meo said that "aeration tunnels", a term he mentioned at the Iolab site visit December 9, refers to a generic group of heated, cellular structures used to aerate sterile products. These structures can be converted *Shipping Containers* ~~railroad boxcars~~ (such as at Medtronic, Incorporated) or other similar units. According to Mr. Meo, many facilities (especially contractors) in California and the Midwest are using these types of structures for at least part of the aeration process. Mr. Meo said there are two types of aeration processes used for these "tunnels." In the static process, the airflow is very small; only a small stream of air is pulled off the top of the container. In the dynamic process, the airflow is constant, and air is allowed to circulate.

CONFIRMATION	<u>sent 02/24/89</u>
RESPONSE	<u>received 3/14/89</u>
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

- ENGINEERING
- PROCESS EQUIPMENT
- COMPLETE SYSTEMS

RECEIVED MAR 14 1989

March 4, 1989

MIDWEST RESEARCH INSTITUTE
401 Harrison Oaks Blvd., Suite 350
Cary, NC 27513

ATTENTION: Sharon Srebro, Chemical Engineer

Thank you for your letter dated February 24, 1989. We appreciate the chance to read over your contact report and make any changes we would like to. Overall, the contact report is accurate and reads well. We would like to make some small changes, however.

We were in error when we told you that our dilution air systems add 169 cubic feet of dilution air for each cubic foot of pure ethylene oxide treated. In fact, we add 370 cubic feet of dilution air for each cubic foot of pure ethylene oxide treated.

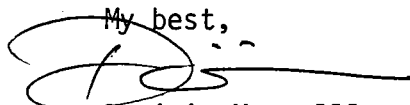
The stated dilution of 100 cubic feet of air for each cubic foot of 12:88 treated is correct. For your benefit, the dilution air requirement for pure ethylene oxide is arrived at logically, knowing that 12:88 is 27 volume percent ethylene oxide. Simply divide 100 cubic feet of air by 0.27 to obtain the 370 cubic feet of air required for each cubic foot of pure ethylene oxide treated.

As a footnote to the dilution air calculations, these calculations are based on steady state conditions, under which no heat is absorbed by the catalyst itself. In practice, some heat is absorbed by the catalyst. We do not allow for heat absorbed by the catalyst, so that as long as the ethylene oxide is diluted in accordance with the stated dilution air requirements, the flow of ethylene oxide into the catalyst bed can run indefinitely, without overheating the bed.

The contact person at Getinge is Omar Hansen, not Omar Hanfen, as you state in your contact report. Also, we believe that the telephone number is (201)370-8800, not 8300, as you state.

Lastly, we believe that the containers commonly used to aerate gas-sterilized product were originally used to ship containerized cargo on board ocean-going ships. We do not think they are converted railroad boxcars.

My best,



Dominic Meo, III
President

DMIII:dg

CONTACT REPORT--MRI Project No. 7723

From: Beth Friedman, Environmental Engineering Department

Date of Contact: January 18, 1989

Contacted by: Telephone

Company/Agency: Medtronic Incorporated
4633 East LaPalma Avenue
Anaheim, California 92807

RECEIVED

AUG 26 1997

OAGPS AIR
DOCKET CONTROL ROOM

Telephone Number: (714) 779-3700

Person(s) Contacted/Title(s)

Richard Shumway, Quality Assurance, Laboratory Manager

CONTACT SUMMARY:

I contacted Mr. Shumway for followup information about the railroad boxcars that are used to aerate sterilized products at Medtronic. I asked Mr. Shumway the following questions.

1. What was the installed cost for each heated ^{shipping container} boxcar?--Mr. Shumway said that the approximate costs for the two boxcars was \$20,000, from "bare lot to installed." However, he was not positive about this estimate and said that he would get back to us with a more accurate cost. He did not say how much the carbon adsorption system cost.

2. What are the dimensions of the ^{shipping containers} boxcars?--8 feet by 8 feet by 40 feet.

3. What is the maximum aeration capacity (in ft³ of product) of each boxcar?--Each unit can hold approximately 9 pallets. Each pallet measures 50 inches by 50 inches by 72 inches.

4. What is the flowrate of the air entering the carbon adsorption system?--Mr. Shumway did not know the flowrate. However, he said that he would provide this information when he gets it.

Mr. Shumway asked what we plan to do with this information. I explained that it would be part of a costing routine to estimate the cost of this technology for the sterilization industry.

CONFIRMATION	Sent 02/24/89
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input checked="" type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 1/26/89

Contacted by: Telephone

Company/Agency: Advanced Air Technologies, Inc. AUG 26 1997
710 S. McMillan Street
Owosso, Michigan 48867

Telephone Number: (517) 723-2171

OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Richard Kruse

CONTACT SUMMARY:

Mr. Kruse was contacted to followup on a conversation between himself and Rebecca Nicholson last summer in which he stated that one of his company's products, a Safe Cell™ Stage II gas/solid reactor system, was going to be installed on a Sterijet® sterilization system. Mr. Kruse stated that the company who had the Sterijet® system has since gone out of business and that the Stage II Safe Cell™ was never installed. I asked him how the emissions from the Sterijet® system would have been routed to the Safe Cell™. He stated that air from the room housing the Sterijet® would be ventilated to the Safe Cell™ much like an aeration room. I also asked Mr. Kruse how the Stage II is sized. He said by flowrate and amount of EO (for replacement of the cells). Finally, I asked him for a "ballpark" figure for an installed cost of a Stage II system for a 2,500 ft³ aeration room with a ventilation rate of 100 to 200 ft³/min. He estimated the total installed capital cost to be between \$5,000 and \$15,000.

CONFIRMATION Sent 02/24/89
RESPONSE
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 1/26/89

Contacted by: Telephone

Company/Agency: DM3, Incorporated
1530 E. Edinger Avenue
Santa Ana, California 92705

Telephone Number: (714) 543-1312

RECEIVED

AUG 23 1997

OAGPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Dominic Meo, President

CONTACT SUMMARY:

Mr. Meo was contacted for clarification of a letter he wrote to Mr. Tim Smith (Bay Area AQMD) in which he implied that the reason for using air dilution as opposed to excess catalyst in a CATCON system was because the temperature could remain below 500°F to 550°F and therefore eliminate the possibility of thermal degradation of CFC-12 in the 12/88 mixture. Mr. Meo stated that the actual reason for using dilution air in large-scale sterilizers (volumes in excess of 42 ft³) is related to the cost feasibility of using dilution air versus excess catalyst.

I also asked Mr. Meo if he could provide the approximate cost (capital installed) of a CATCON system to control a 2,500 ft³ aeration unit. He stated that the CATCON system he sold to IOLAB was \$75,000 (sized on a 500 ft³/min ventilation rate). The cost of the room (or chamber) was \$49,000 and the electrical and mechanical hookups and associated design labor were another \$40,000 for a total of \$164,000.

CONFIRMATION _____
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input checked="" type="checkbox"/> NONE <input type="checkbox"/>

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 2/14/89

Contacted by: Telephone

RECEIVED

Company/Agency: California Air Resources Board (CARB) **NOV 26 1997**
Post Office Box 2815
Sacramento, California 95812

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (916) 322-2990

Person(s) Contacted/Title(s)

Rich Vincent / *Staff Air Pollution Specialist*

CONTACT SUMMARY:

Mr. Vincent was contacted to provide some information on whether CARB has specific regulations in place or in development for emissions of ethylene oxide (EO). He said that CARB is starting a study this year on EO emissions from large sterilizers, but that the ^{any} regulation probably would not be proposed for ~~at least~~ a year. He noted that the Bay Area District is currently working on a draft rule for large sterilizers. A contact person in the Bay Area District is Tim Smith. Art Siegel and Mustafa ~~El Shariffe~~ ^{E/Sharif} are contacts in the South Coast District.

and hospitals

CONFIRMATION	<i>mail ed 02/02/89</i>
RESPONSE	<i>3/10/89</i>
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 2/14/89

Contacted by: Telephone

RECEIVED

Company/Agency: Colorado Department of Health
4210 E. 11th Avenue
Denver, Colorado 80220

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (303) 331-8578

Person(s) Contacted/Title(s)

John Clouse

John M. Clouse
3/7/89

CONTACT SUMMARY:

Mr. Clouse was contacted to provide information on whether the State of Colorado has undertaken any air toxics regulation development, especially for ethylene oxide emissions. He stated that at the present, no such regulations are being developed.

CONTACT REPORT--MRI Project No. 7723

From: Brenda Shine, Environmental Engineering Department
Date of Contact: 2/14/89
Contacted by: Telephone
Company/Agency: Florida Department of Environmental Regulation
of Air Resources Management
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RECEIVED

AUG 26 1997

OAGRS AIR
DOCKET CONTROL ROOM

Telephone Number:

Person(s) Contacted/Title(s)

John Glenn

CONTACT SUMMARY:

Mr. Glenn was contacted to provide information on what, if any, regulations are in place or currently being developed to regulate emissions of ethylene oxide (EO). Mr. Glenn stated that the general new source permitting standards and permit renewals require the maximum risk level for sources to be 10^{-6} . He mentioned that Hillsborough County (Tampa area) was the first county to subject EO sources to this requirement.

CONFIRMATION	<i>mailed 9/3/02/89</i>
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Brenda Shine, Environmental Engineering Department
Date of Contact: 2/14/89
Contacted by: Telephone
Company/Agency: Michigan Department of Natural Resources, OAPS AIR Quality
Division
Post Office Box 30028
Lansing, Michigan 48909

RECEIVED

AUG 26 1997

DOCKET CONTROL ROOM

Telephone Number: (517) 373-7023

Person(s) Contacted/Title(s)

Paul Schleusener, Permit Engineer

CONFIRMATION	<i>mailed 3/2/89</i>
RESPONSE	<i>3/6/89</i>
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Schleusener was contacted to provide information on what, if any, regulations are in place or currently being developed to regulate emissions of ethylene oxide. Mr. Schleusener stated that no specific air toxics regulation is currently in place, but that EO is treated as a cancer-causing agent and therefore new sources that emit EO must be permitted as part of the general review/approval policy. The health effects portion of permit review is based on a maximum risk level of 10^{-6} . All new sources (including hospital sterilizers) emitting EO must undergo the permitting process. There is no schedule for review of sources pre-dating permit requirements. Mr. Schleusener suggested that I contact Danita Brandt (517) 373-7078 for more information on EO permit reviews.

From: Brenda Shine, Environmental Engineering Department
Date of Contact: 2/14/89
Contacted by: Telephone
Company/Agency: New Jersey Department of Environmental Protection Bureau
of Air Pollution Control
CN 027, 401 E. State Street
Trenton, New Jersey 08625
Telephone Number: (609) 292-6704

RECEIVED
AUG 26 1997
OAQPS AIR
DOCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Joann Held

CONTACT SUMMARY:

Ms. Held was contacted to provide information on what, if any, regulations are in place or currently being developed to regulate emissions of ethylene oxide (EO). Ms. Held stated that New Jersey's permitting requirements are based on a case-by-case basis. Best available control technology (BACT) is required for new sources.

Joann L. Held
3/6/89

CONTACT REPORT--MRI Project No. 7723

A-88-03

A-88-03

II E 339

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 2/14/89

Contacted by: Telephone

Company/Agency: New York Department of Environmental Conservation
Division of Air Quality
50 Wolf Road
Albany, New York 12233

Telephone Number: (518) 457-7688

Person(s) Contacted/Title(s)

Eric Wade

CONTACT SUMMARY:

Mr. Wade was contacted to provide information on what, if any, regulations are in place or currently being developed to regulate emissions of ethylene oxide (EO). Mr. Wade stated that permitting requirements are based on a maximum risk level of 10^{-6} , as applied to new or modified sources.

CONFIRMATION <i>mailed 03/03/89</i>
RESPONSE
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

From: Brenda Shine, Environmental Engineering Department
Date of Contact: 2/14/89
Contacted by: Telephone
Company/Agency: Rhode Island Department of Environmental Management,
Division of Air and Hazardous Materials
291 Promenade Street
Providence, Rhode Island 02908

Telephone Number: (401) 277-2808

Person(s) Contacted/Title(s)

Barbara Morin

CONTACT SUMMARY:

Ms. Morin was contacted to provide information on what, if any, regulations are in place or currently being developed to regulate emissions of ethylene oxide (EO). Ms. Morin stated that Rhode Island has a separate air toxics regulation (which applies to EO) that is based on a maximum risk level of 10^{-6} . She stated that, in some cases, if the particular industry can demonstrate that the control technology on the source is best available control technology (BACT) and that the emissions reduction is the lowest attainable emission reduction (LAER), they can grant the source a permit based on a maximum risk level of 10^{-5} . Ms. Morin noted that the Rhode Island regulation, as it stands, is ineffective for regulating EO because of a clause that exempts sources that are regulated under other FIFRA. In the case of EO, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) has been interpreted in Rhode Island to be applicable to spice sterilizers and fumigation units. Ms. Morin stated that the current Rhode Island regulation would be changed in the near future, (these things always take longer the expected) and that the new version is expected to apply to all EO emission sources.

RECEIVED

AUG 25 1997

QAQPS AIR
DOCKET CONTROL ROOM

CONFIRMATION

mailed 3/10/89

RESPONSE

3/13/89

NOTED
VERIFIED
DONE

II E 341
A-88-03

CONTACT REPORT--MRI Project No. 8951-19

From: Brenda Shine, Environmental Engineering Department

Date of Contact: 2/28/89

Contacted by: Telephone

Company/Agency: Texas Air Control Board (TACB)
6330 Highway 290 East
Austin, Texas 78723

Telephone Number: (512) 451-5711

RECEIVED

AUG 2 1997

OAGPS AIR
BUCKET CONTROL ROOM

Person(s) Contacted/Title(s)

Mr. Lane Hartsock, Chief, Regulatory Development

CONTACT SUMMARY:

Mr. Hartsock was contacted for information on whether the State of Texas is currently developing any specific regulations on ethylene oxide emissions. Mr. Hartsock stated that there are currently no plans for an EO regulation but that EO is one of the pollutants that is modeled to make sure that the applicable health risk level is not exceeded when a new source is initially permitted.

CONFIRMATION <u>sent May 13, 1989</u>
RESPONSE _____
WRITTEN <input checked="" type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input type="checkbox"/>

CONTACT REPORT--MRI Project No. 7723

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 03/01/89

Contacted by: Telephone

Company/Agency: Michigan Science and Engineering Associates
Post Office Box 7105
Ann Arbor, Michigan 48107

Telephone Number: (313) 994-0280

Person(s) Contacted/Title(s)

Dr. David Hammer, Consulting Chemical Engineer

RECEIVED INFORMATION sent 04/04/90
RESPONSE
OAQPS AIR
DOCKET CONTROL ROOM
WRITTEN ☒
VERBAL ☐
NONE ☐

CONTACT SUMMARY:

Dr. Hammer phoned me in response to my February 23 call to Richard Kruse of Advanced Air Technologies. Dr. Hammer is a consulting engineer to Advanced Air. I asked Dr. Hammer the following questions about the Safe-Cell™ Stage II gas/solid reactor system to control EO emissions from a heated cellular aeration room.

1. What is the cost (f.o.b.) of a Stage II system designed to handle an inlet flow of 1,000 ft³/min? What are typical installation costs for the system?--Dr. Hammer did not know these costs because the units are custom designed. However, he said that he would develop the design specifications and submit them to Advanced Air for a cost estimate. He said that cost estimates should be available by the end of March.

2. The heated aeration cells operate at temperatures greater than 100°F (up to 130°F). Does this present any problems for the Stage II system?--No.

3. In a June 22, 1988, letter to David Markwordt (EPA/CPB), Dr. Hammer stated that the reactor can "handle feed concentrations of EtO in the percent range, for short periods of time." What are the limitations on inlet EtO concentrations under long-term operating conditions? Are these limitations due to technical or economical reasons?--Dr. Hammer replied that there are no technical limitations on the inlet flow, temperature, or concentration. (Although there are no data available on the operating efficiency with low temperatures [e.g., <50°F], Dr. Hammer stated that the efficiency should not be affected appreciably.) However, a high inlet EtO flowrates or concentration will increase the replacement costs for the solid packing. Therefore, for inlet concentrations greater than 100 ppmv, a Stage I acid-water scrubber is more economically attractive than the Stage II reactor.

4. How is disposal of the solid waste handled?--Dr. Hammer stated that Advanced Air is responsible for the disposal. The nontoxic, polymeric product is sent to a landfill. (The present disposal alternatives are to landfill or incinerate.) As the number of customers increase, Advanced Air plans to regenerate the spent packing.

5. What are approximate operating and maintenance costs?--Dr. Hammer stated that O&M costs are minimal. The utility costs consist of electricity for a 2-hp fan. Other costs include replacement of the solid packing. For a 700 ft³/min system (a 5.5 feet by 4 inch cylinder), replacement of the packing costs about \$2,000. The 700 ft³/min system can treat approximately 160 pounds of EtO before the packing needs to be replaced.

CONFIRMATION <u>Sent 05/16/89</u>
RESPONSE _____
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input type="checkbox"/>

CONTACT REPORT--MRI Project No. 7723

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 3/6/89

Contacted by: Telephone

Company/Agency: B&D Industries
7900 N. Kolmar
Skokie, Illinois 60076

Telephone Number: (312) 673-1441

Person(s) Contacted/Title(s)

John Hoffman

RECEIVED	
CONFIRMATION	SENT 05/19/89
AUG 7 1997	
RECEIVED OPS AIR	
DOCKET CONTROL ROOM	
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Hoffman called David Markwordt (CPB/EPA), who then set up a 3-way teleconference. Mr. Hoffman called to discuss the recovery of ethylene glycol from the aqueous glycol solution produced by acid-water scrubbing of ethylene oxide (EO). He said that B&D Industries will pay 3 to 6 cents a gallon for the aqueous glycol solution if the ethylene glycol concentration is at least 45 percent, by weight. If the concentration is between 40 and 45 percent, Mr. Hoffman said the price is less than 3 cents. (He did not state how much the price is reduced.) If the glycol concentration is less than 40 percent, the mixture is not acceptable for recovery. Mr. Hoffman said that the scrubbing liquor in a chemical scrubber is approximately 50 percent glycol at the changeout point; the liquor from a Damas scrubber is approximately 60 percent glycol at changeout.

B&D Industries picks up the scrubber wastewater at the facility and pays freight charges. The company will accept bulk quantities or 55-gallon drums, but bulk is preferred. Mr. Hoffman stated that a Chemrox scrubber produces about 4,500 gallons of aqueous glycol; a Damas scrubber produces about 5,000 gallons. In addition, Mr. Hoffman said that the facility's sewer bill may be reduced if the liquor is sent to a recovery company instead of being discharged to the sewer. Sewer treatment rates at most POTW's are based on the amount of water used (i.e., assuming that all water used will be discharged as wastewater).

The facility must increase the pH of the glycol solution to between 2.5 and 7.0 by treatment with sodium hydroxide (caustic) only. The actual pH required will depend on State regulations regarding the shipment of hazardous wastes. However, the pH must be at least 2.5 because Illinois (B&D is in Illinois) State regulations classify chemical shipments with a pH of 2 or less as hazardous. According to Mr. Hoffman, it is cheaper to raise the pH than to pay the additional cost for hazardous waste shipment.

The facility must provide a Material Safety Data Sheet for the glycol solution. This requirement is only for the first pickup.

If both propylene oxide and EO emissions are treated by the scrubber, the propylene glycol concentration must not exceed 3 percent of the total glycol concentration. (Some contract facilities use EO and propylene oxide). Mr. Hoffman said that B&D Industries is examining the recovery of propylene glycol from facilities that use exclusively propylene oxide (e.g., some spice fumigators).

Presently, B&D Industries buys the glycol solution from the sterilization facility and then sells it to a distiller in Chicago, which distills out the mono-, di-, and triglycols and sells them to a plastics company. Mr. Hoffman said that B&D plans to start recovering the glycol onsite in the future.

Mr. Hoffman said that two of B&D's clients are Griffith Micro Science in Illinois and sterile design (a Johnson & Johnson subsidiary) in Florida.

B&D Industries will be changing its name to Med-Chem Reclamation, Inc., in a few weeks. The company also has contracts with some Chicago hospitals to recycle plastics from the hospitals.

Mr. Hoffman asked for the three recovery companies that were mentioned in the EO background information document. These companies are listed below.

Mr. Roy Hadley
High Valley Chemicals
1151 S. Redwood Road
Suite 105
Salt Lake City, Utah 84104
(801) 973-7966

Mr. Charles Duesing
Bull Chemical Company
2828 East Hardy Street
Spring, Texas 77373
(713) 370-6442

Mr. Richard Immerman
Ore Corporation
2415 Woodmere Drive
Cleveland, Ohio 44106
(216) 371-4869

Ore Corporation has stopped accepting ethylene glycol for recovery. Bull Chemical Company in Texas does not exist under that name any more. (Chemrox supplied the name of this recovery facility). However, another recovery facility was recently identified that accepts the spent scrubbing liquor. The contact at that company is:

Mr. Jerry Duvow
Chemstreams, Inc.
3501 River Road
Matthews, North Carolina 28106
(704) 821-9184

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 03/10/89

RECEIVED

Contacted by: Telephone

AUG 23 1997

Company/Agency: South Coast Air Quality Management District
9150 Flair Drive
El Monte, California 91731

DOCKET CONTROL ROOM

Telephone Number: (816) 571-5158

Person(s) Contacted/Title(s)

WRITTEN ☐
VERBAL ☐
NONE ☒

George Ames

CONTACT SUMMARY:

Mr. Ames called David Markwordt (EPA/CPB) who then set up a 3-way teleconference. Mr. Ames called to provide information about an add-on control for hospital sterilizers that AMSCO has developed in cooperation with Donaldson Company. The system uses air ejectors, instead of a vacuum pump, to evacuate the sterilizer. The sterilizer outlet stream is then discharged to a catalytic oxidizer, which was developed by Donaldson Company. Diluent air (100 ft³/min) is added to the sterilizer exhaust. The system is designed so that if the temperature of the catalytic oxidizer is too low for proper combustion, the air ejectors will not evacuate the sterilizer until the temperature increases.

Mr. Ames said that AMSCO sells the sterilizer/catalytic oxidizer as a packaged system and that AMSCO is responsible for the upkeep. He said that AMSCO is installing one of these sterilizer systems at a hospital in the South Coast area. After the system is installed, an independent testing laboratory will do an efficiency study. Mr. Ames said that he will send the test data to David Markwordt (EPA) when the study is complete (around the end of April). A contact with AMSCO about the new sterilizer design is Ralph Makinen, Manager of Technical Services (phone: 814-870-8198).

Mr. Ames said that SCAQMD uses the NIOSH method to analyze low concentrations of ethylene oxide (EO). The EO samples are collected in charcoal-coated tubes and subsequently converted to 2-bromoethanol for analysis. Mr. Ames said that SCAQMD is trying to get the detection limit down to the 3 ppbv range. However, he said that determining the actual detection limit for EO is difficult; because EO is very reactive, some of the sample may be lost.

Mr. Ames was asked about the EO control efficiency study that SCAQMD conducted on the flare located in the South Coast area. He said that the test only measured the EO concentration at the flare outlet. The efficiency was calculated based on the amount of EO initially charged to the sterilizer. He said that he would send the test data on the flare to David Markwordt.

A-88-03

CONTACT REPORT--MRI Project No. 7723

II E 345

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 3/16/89

Contacted by: Telephone

Company/Agency: Chemstreams, Inc.
3501 River Road
Mathews, North Carolina 28106

Telephone Number: (704) 821-6727

Person(s) Contacted/Title(s)

Jerry Duvow

RECEIVED

AUG 2 1997

QA/QPS AIR
DOCKET CONTROL

CONFIRMATION Sent 3/19/91.
ROOM
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input checked="" type="checkbox"/>

CONTACT SUMMARY:

Mr. Duvow was contacted about accepting ethylene glycol scrubbing liquor (from acid-water hydrolysis of ethylene oxide) for recovery.

Chemstreams will purchase the ethylene glycol solution, but only in bulk quantities (they pick up). Mr. Duvow stated that Chemstreams prefers a pH of 6 to 7, but they will accept a pH of 2 to 3 (stainless steel tanker). The solution must contain 20-22% ethylene glycol (weight %) minimum.

CONTACT REPORT--MRI Project No. 7723

II E 346

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 3/16/89

RECEIVED

Contacted by: Telephone

AUG 2 1997

Company/Agency: Donaldson Co.
Post Office Box 1299
1400 West 94th Street
Minneapolis, Minnesota 55440

OAGPS AIR
DOCKET CONTROL ROOM

Telephone Number: (612) 887-3710

Person(s) Contacted/Title(s)

Mr. Cary Olson

CONTACT SUMMARY:

Mr. Olson was contacted to obtain information regarding the disposal of catalyst from the Eto Abator. Mr. Olson said that the catalyst should be replaced every 4-5 years. He said that a GC could be used to check inlet and outlet concentrations to the control to provide a basis for the replacement of catalyst. He provided a disposal cost of \$80/400 lb of catalyst which was developed by Waste Management in Chicago.

He said that Durkee controls a 600 ft³ sterilizer with an Eto Abator catalytic oxidizer. Several sterilizers (390, 190, and 30 ft³) at an Allergan facility are also controlled by a catalytic oxidizer (Eto Abator). In Ireland three 1,200 ft³ sterilizers are being controlled by one 3,000 cfm Eto Abator). ~~In Ireland three 1,200 ft³ sterilizers are being controlled by one 3,000 cfm Eto Abator.~~

Eto Abators are also being used to control smaller sterilizers such as those manufactured by American Sterilizer. These sterilizers are in place at Antelope Valley Hospital, San Antonio Hospital, Pacesetters Systems, Advanced Cardiovascular Systems, University of California at Irvine, and AMI. All of these sterilizers are controlled with Eto Abators.



7723-3/36

Mr. Olson also stated that exposure to ethylene oxide is limited by a Threshold Limit Value (TLV-C) of 50 ppm set by OSHA (Volume 54, No. 12). He also said that as of January 19, 1989 ethylene glycol was listed in the Federal Register OSHA standard.

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 3/16/89

RECEIVED

Contacted by: Telephone

AUG 28 1997

Company/Agency: High Valley Chemical
1151 South Redwood Road
Suite 105
Salt Lake City, Utah 84104

OAQPS AIR
DOCKET CONTROL ROOMCONFIRMATION *Sent 3/19/91*

RESPONSE

Telephone Number: (801) 973-7966

Person(s) Contacted/Title(s)

Mr. Keven Dalton

WRITTEN ☐
VERBAL ☐
NONE ☒

CONTACT SUMMARY:

Mr. Dalton was contacted about High Valley accepting ethylene glycol scrubbing solution (from the acid-water hydrolysis of ethylene oxide) for recovery.

High Valley does accept ethylene glycol scrubbing solution on a no cost/no payment basis. The facility must pay shipping charges.

Only ethylene glycol solutions of >45 wt % are accepted.

CONTACT REPORT--MRI Project No. 7723

From: Sharon Srebro, Environmental Engineering
Department

Date of Contact: 3/17/89

Contacted by: Telephone

Company/Agency: Donaldson Company, Inc.
Post Office Box 1299
1400 West 94th Street
Minneapolis, Minnesota 55440

Telephone Number: (612) 887-3710

Person(s) Contacted/Title(s)

Mr. Cary Olson, Market Manager

RECEIVED

AUG 26 1997

CONFIRMATION	Sent 3/19/91
ROOM	
RESPONSE	3/26/91
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT REPORT:

Mr. Olson was contacted to request information on the ETO Abator TM catalytic oxidizer.

According to Mr. Olson the 2,000 ft³/min unit has a pressure drop of approximately 2 inches across the unit.

From: Sharon Srebro, Environmental Health Department

Date of Contact: 3/17/89

AUG 26 1997

Contacted by: Telephone

Company/Agency: Medtronic Incorporated
4633 East LaPalma Avenue
Anaheim, California 92807

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (714) 779-3700

Person(s) Contacted/Title(s)

Mr. Richard Shumway, Quality Assurance, Laboratory Manager

CONFIRMATION Sent 3/19/9
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input checked="" type="checkbox"/>

CONTACT SUMMARY:

Medtronic was contacted to obtain cost information on the aeration units (i.e., shipping containers) they use.

According to Medtronic, the installed cost for both units was \$32,000, including the control device. The freight on board (F.O.B.) cost was \$6,000 for each unit. The remaining \$20,000 was for labor, installation, gas lines, electric lines (buried), ducting, and the carbon adsorption control device.

If the unit is installed in a climatologically wet region, inside installation is recommended. The total theoretical flow for the combined units is 1100 cfm based on the blower rating and ducting diameter. The ductwork enters both boxes and runs 3/4 the length of the unit. The ductwork inside the aeration unit is baffled with evenly distributed vents.

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 3/30/89

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: American Sterilizer Company
2424 West 23rd Street
Erie, Pennsylvania 16514

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: 814-870-8198

Person(s) Contacted/Title(s)

Ralph Makinen, Director of Technical Services

CONTACT SUMMARY:

I called Mr. Makinen to obtain information about the air ejector/catalytic oxidation control system that American Sterilizer (AMSCO) is developing. (See telecon. Srebro, S., with Ames, G., SCAQMD. March 10, 1989.)

Mr. Makinen said that the control unit is designed to be retrofitted to existing hospital sterilizers. The sterilizer is evacuated by means of air ejectors instead of a vacuum pump. However, the vacuum pump is used for the preconditioning (presterilization) step because the air ejectors cannot pull as deep a vacuum as the pump.

Mr. Makinen said the system is still in the developmental stage but should be available by the end of this year. He said that the system that is being installed in Southern California is an engineering prototype. Although the system is still being developed, AMSCO is installing the prototype unit in California because of the South Coast Air Quality Management Districts' (SCAQMD) stringent regulation for modified sterilizers. Mr. Makinen said that the unit in California will be used for testing and development purposes as well as serving as an emission control system for the sterilizer.

NOTE: ON 2/26/91 Beth Friedman and Val deLillo decided that this telecon would not be sent out for confirmation because the information contained herein can be found in other telecons.

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 4/3/89

Contacted by: Telephone

Company/Agency: Chemrox Inc.
217 Long Hill Crossroads
Shelton, Connecticut 06484

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (203) 926-9081

Person(s) Contacted/Title(s)

Mr. Pankaj Desai, Vice President of Sales and Marketing

CONTACT SUMMARY:

Mr. Desai was contacted to obtain information regarding the Freoxx™ CFC-12 recovery unit that Chemrox manufactures. He said that there has been a recovery unit in operation since June 1988 when testing was first performed. This recovery unit finally went into routine operation in November 1988.

He said that the facility operates two 1000 ft³/min sterilizers and the overall recovery of CFC's has been 78 percent of the amount charged to the sterilizers. Because the recovery unit only recovers CFC's from the first sterilizer evacuation, the recovery unit is actually capturing 98 percent of the CFCs that enter the recovery unit. Mr. Desai indicated that the recovery unit as it is presently configured may be economically infeasible for facilities with small sterilizers or low sterilant gas use. However, for the facility previously mentioned, Mr. Desai estimated a payback of two years for the recovery unit.

Mr. Desai indicated that he had spoken with Mr. Steve Conviser from Union Carbide and was told that Union Carbide would buy all the CFC's recovered by the Freoxx™ recovery unit. He said he was unsure how the

recovery system would perform with the CFC alternatives that will be used in the future.

CONTACT REPORT--MRI Project No. 7723

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 4/4/89

Contacted by: Telephone

Company/Agency: Donaldson Company OAQPS AIR RESPONSE
Post Office Box 00000 CONTROL ROOM
1400 West 94th Street
Minneapolis, Minnesota 55440

Telephone Number: (612) 887-3710

Person(s) Contacted/Title(s)

Mr. Cary Olson, Market Manager

CONTACT SUMMARY:

Mr. Olson was contacted to obtain cost information for EtO Abator TM catalytic oxidizers.

Mr. Olson said the units have a life expectancy of 20 years. He provided the following costs were conveyed during the conversation:

The costs quoted above have increased from the estimates provided in a May 12, 1988 telecon.

The heater energy requirements are as follows (only half the actual KW are used to heat because of 70 percent heat recovery)

Flow (ft ³ /min)	KW
1,000	80
3,000	120
6,000	180
9,000	230
12,000	290* *Estimated

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AUG 26 1997

CONFIRMATION sent 3/19/91

3/26/91

WRITTEN ☒ VERBAL ☐ NONE ☐

Catalyst replacement costs are as follows:

Total replacement cost is \$1800/cell

<u>Flow</u>	<u>No. Cells</u>
1,000	4
3,000	16
6,000	32
9,000	48
12,000	64

For disposal of catalyst (ref. Waste Management, Chicago) the cost will be approximately \$80/400 lb. Each cell contains approximately 80 to 100 lbs of catalyst.

A-88-03

CONTACT REPORT--MRI Project No. 7723

II E 353

From: Sharon Srebro, Environmental Engineering
Department

Date of Contact: 4/10/89

Contacted by: Telephone

Company/Agency: Michigan Science and Engineering
Post Office Box 7105
Ann Arbor, Michigan 48106

Telephone Number: (313) 994-0280

Person(s) Contacted/Title(s)

Dr. David Hammer/Consultant to Advanced Air Technologies

CONTACT SUMMARY:

Dr. Hammer was contacted to obtain information regarding the Safe-Cell 2 gas/solid reactor. He stated that the base size of the reactors is a 1,000 ft³/min unit that has the dimensions of 4 ft. x 4 ft. x 6 ft. He said the reactor size increases proportionally with an increase in flow through the control. For this reason he said space availability is a primary consideration.

Dr. Hammer also indicated that other factors must be considered when purchasing a control and these are: (1) How much EO will be processed through the control. (2) What is the flowrate to be accommodated by the control. He said that for flow requirements larger than 1,000 ft³/min, the equation (ft³/min)^{0.7} (cost of 1,000 ft³/min control) can be used to estimate the costs of larger control units. He stated that this equation should be used with caution. A 1,000 cfm unit would cost about \$22,500.

Dr. Hammer was asked about costs associated with the changing of spent reactant. He said that 4+ man-hours would be required to change the reactant. Fresh reactant would cost about \$4,400 (removal of 180 lb of EO).

RECEIVED

AUG 26 1997

OAGPS AIR
48106 CONTROL ROOM

WRITTEN ☒
VERBAL ☐
NONE ☐

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 5/2/89

Contacted by: Telephone

Company/Agency: DM3, Incorporated
1530 East Edinger Avenue
Suite 5
Santa Ana, California 92705

Telephone Number: (714) 543-1312

Person(s) Contacted/Title(s)

Mr. Donimic Meo, President

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONFIRMATION	Sent 3/19/91
RESPONSE	
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

CONTACT SUMMARY:

Mr. Meo was contacted to obtain information about the catalyst that is used in DM3's Catcon System. He gave the following properties and composition of the hopculite catalyst:

Composition

MnO₂ 78.3% (w/w)
CUO 13.1% (w/w)
ignition loss 7.9% (w/w)

Physical properties

p (density) = 1 g/cm³
surface area = 150 m²

Mr. Meo said that the catalyst was stable in the oxide form and could therefore be disposed of in this form. However, as an oxidizer, the catalyst would be considered a D.O.T. hazard. In order to dispose of the catalyst without it becoming a D.O.T. hazard, Mr. Meo suggested wetting the catalyst prior to disposal. He said Mine Safety Alliance (MSA) does not recommend wetting the catalyst because it will degrade.

Mr. Meo also mentioned a report that was written on the degradation of Halogens that is applicable to catalytic oxidizers. The report is in Industrial Engineering Chemistry, Vol.13, No.3 (1974, p. 175) and is entitled "Catalytic Decomposition of Halogen." The report was subpublished by the Navy Product Research Development and was written by Jim Musick and Brad Williams of the Chemical Division of the Naval Research Laboratories.

From: Sharon Srebro, Environmental Engineering Department

RECEIVED

Date of Contact: 5/8/89

AUG 26 1997

Contacted by: Telephone

Company/Agency: Donaldson Company
Post Office Box 1299
1400 West 94th Street
Minneapolis, Minnesota 55440

OAQPS AIR DOCKET CONTROL ROOM

CONFIRMATION	sent 3/19/91
RESPONSE	3/26/91
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

Telephone Number: (612) 887-3710

Person(s) Contacted/Title(s)

Mr. Cary Olson, Market Director

CONTACT SUMMARY:

Mr. Olson was contacted in order to obtain fan horsepower requirements for fans used with catalytic oxidation control units that Donaldson manufactures. He stated that the control units are designed for duct velocities of 250-500 ft/min and flowrates of 200 ft/min across the catalyst bed. He estimated the following fan horsepower requirements for the following units:

<u>ft³/min</u>	<u>HP</u>
100	0.6
500	2
1,000	5
3,000	10
6,000	20
9,000	30
12,000	40

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 5/9/89

RECEIVED

Contacted by: Telephone

AUG 2 1997

Company/Agency: MSA/Divison of Callery Chemical
Post Office Box 429
Pittsburg, Pennsylvania 15230OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (412) 967-4255

Person(s) Contacted/Title(s)

Mr. Popo

James W. Popp Mar. 25, 1991

CONTACT SUMMARY:

Mr. Pop was contacted about disposal of hopculite catalyst (used in catalytic oxidizers).

According to Mr. Pop hopculite should not be stored near hydrocarbons because it can ignite. Also, when hopculite gets wet it turns into slush and is no longer reactive (i.e., will not oxidize chemicals). Hopculite does not need to be wetted it is a non hazardous normally. In Pennsylvania, hopculite must be taken to an industrial landfill because of Pennsylvania regulations. Federal regulations view hopculite a nonhazardous.

Hopculite is a primary and secondary absorbent as well as a catalyst.



Callery Chemical Company

P.O. Box 429
Pittsburgh, PA 15230

Div. of Mine Safety Appliances Co.



Boron Chemicals • Organometallics • Alkali Metals • Specialty Chemicals

HOPCALITE[®] CATALYST TCLP TEST RESULTS

Based upon the results of a Toxicity Characteristic Leaching Procedure (TCLP) analysis of Hopcalite[®] Catalyst, it has been shown that the catalyst does not meet the current definition of a hazardous waste due to its metal content. The following are results of the TCLP run on production Hopcalite[®] Catalyst:

<u>TESTS</u>	<u>METHOD</u>	<u>MCL*</u>	<u>HOPCALITE</u>
Arsenic	7061 (mg/l)	5.0	<0.01
Barium	7080 (mg/l)	100.0	<0.10
Cadmium	7140 (mg/l)	1.0	<0.01
Chromium	7190 (mg/l)	5.0	<0.01
Lead	7420 (mg/l)	5.0	0.16
Mercury	7470 (mg/l)	0.2	<0.005
Selenium	7441 (mg/l)	1.0	<0.01
Silver	7760 (mg/l)	5.0	0.02

*Maximum contaminant level

These results are only valid for Hopcalite[®] Catalyst that has been taken directly from Callery's production process and never used as a catalyst or a sorbent in any application. Use of this catalyst can introduce contaminants into the granules which might lead to very different results in a TCLP analysis, results which might show the contaminated catalyst to be a characteristic hazardous waste due to its metal and/or organic content.

Callery recommends that its users of Hopcalite[®] Catalyst carefully evaluate their handling and use of the product. An additional TCLP test may be required to determine if waste catalyst is hazardous waste.

12/4/90

JWP:db

LOCATION: Route 309 • Mars-Evans City Road • Callery, PA 16024

RECEIVED MAR 27 1991

CALLERY CHEMICAL COMPANY • P.O. Box 429 • Pittsburgh, PA 15230 • Telephone: (412) 967-4100

March 25, 1991

Valentine V. Deolloqui
Midwest Research Institute
Suite 350
401 Harrison Oaks Boulevard
Cary, NC 27513

Dear Mr. Deolloqui:

Although my conversation with Sharon Srebro was on May 9, 1989, I remember it. I want to expand upon the points of our discussion, which, as they stand, are generally correct.

1. Hopcalite[®] Catalyst is active against ozone (O_3), carbon monoxide (CO) and a variety of hydrocarbons and substituted hydrocarbons. O_3 and CO exist as gases, and the hydrocarbons are either gases or are capable of existing as vapors. If these gases or vapors find their way into an open can of catalyst, the appropriate catalytic reaction could begin. O_3 would be converted to O_2 , CO would be converted to CO_2 and hydrocarbons converted from "HC" to CO_2 and H_2O vapor. Each of these reactions are attended by an increase in the temperature of the catalyst; an effect of the heat of reaction for the specific conversion reaction occurring. The rise in temperature is proportional to the concentration of the reactant being converted, so very high reactant concentrations could produce large temperature increases. If any flammable materials are in close contact with the catalyst (rags lying on top of the catalyst in the drum), they could ignite, starting a fire. Basically, the catalyst itself is not flammable, but it could get hot enough to start fires with other materials under the proper set of circumstances.
2. Wet Hopcalite will definitely become deactivated. When wet catalyst is dried, some of the catalytic activity may return. Physically, Hopcalite is nothing more than a powder that has been pressed into a hard cake and then granulated. If the Hopcalite granules are soaked in a bucket containing a large portion of water, the granules will ultimately fall apart, forming a mud in the bottom of the bucket.
3. Hopcalite is considered a DOT nonhazardous material for transportation purposes. When Hopcalite is considered for

March 25, 1991
Valentine V. Deolloqui
Midwest Research Institute
Page 2

CALLERYCHEMICAL COMPANY

disposal purposes, several factors must be taken into account. In whatever process in which the Hopcalite has been employed, has that process in any way contaminated the catalyst? If the Hopcalite adsorbed or absorbed things such as mercury or polychlorinated biphenyls (PCBs), then the Hopcalite must be considered hazardous due to mercury or PCB content.

A toxicity characteristic leaching procedure (TCLP) has been run on Hopcalite since we have had our conversation. These results are attached. They show our catalyst in its unused, pure form, not to be a characteristically hazardous waste due to its metal content. This same paper, however, warns users to evaluate their handling and use of the product to determine whether or not they may have added something to the catalyst that might, in fact, change its hazard classification. Finally, all Federal, State, and Local laws must be obeyed when disposing of a chemical waste. Our Pennsylvania State laws, and apparently the laws in the locale of the disposal site, allow Hopcalite to be disposed of under standard industrial landfill conditions. Other states, and the individual municipalities within them, may have other laws concerning the disposal of manganese dioxide/copper oxide mixtures.

Sincerely,

CALLERY CHEMICAL COMPANY

James W. Popp

James W. Popp
Chemical Sales

JWP:db
enclosures

From: Valentine deOllouqui, Environmental Engineering Department

Date of Contact: 10/15/89

Contacted by: Telephone

Company/Agency: CR BARD
731 Central Avenue
Murray Hill, New Jersey 07974

Telephone Number: (201) 277-8409

Person(s) Contacted/Title(s)

Joe Kiceina, Corporate Manager

RECEIVED

AUG 26 1997

ey 07974 OAQPS AIR
DOCKET CONTROL ROOM

ED
CONFIRMATION *Feb 7, 1990*
97
R
DL ROOM
WRITTEN
VERBAL ☐
NONE ☒

CONTACT SUMMARY:

Mr. Kiceina was contacted in regard to the July 1989 EPA information request. He was asked whether there were any controls on sterilizers at any of his companys' facilities. In reply he stated that at the present time there were no controls on any of their sterilizers but that there were plans to control sterilizer emissions at their Covington, Georgia, facility. he also stated that there were studies being done to address controls at several of the other facilities.

He was also asked what type of vacuum pump was being used with their sterilizer. He said that they used an oil and water vacuum pump with no recovery feature.

From: Valentine deOllolqui, Environmental Engineering Department

Date of Contact: 10/15/89

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Johnson & Johnson
One Johnson & Johnson Plaza
New Brunswick, New Jersey 08933-7002

OAQPS AIR

DOCKET CONTROL ROOM

Telephone Number: (201) 422-5618

Person(s) Contacted/Title(s)

Mr. David Woody, Plant Manager

CONFIRMATION Feb 7, 1990

RESPONSE

WRITTEN ☐VERBAL ☐NONE ☒

CONTACT SUMMARY:

Mr. Woody was contacted regarding the ethylene oxide emissions that his company reported in the July 1989 EPA information request. It was not clear how the numbers given for EO emissions were divided. Mr. Woody said that the initial 1985 emissions were projected from their production schedule at the time, which, as it turns out was underestimated. Therefore, the corrected figures were larger. He also said that scrubbers were installed in late 1985 and run intermittantly until early 1988 when the company made a decision not to operate the sterilizers without controls. This decision also applies to their other facilities in Sherman, Texas, which had a scrubber that went into place in 1987 and on-line in early 1988. He cited this over estimation of the aeration vent and impound warehouse as another possibility for misinterpretation of the emissions that were given.

He described the aeration process by saying that the sterilized products come out of the sterilizer on a conveyor belt where they are allowed to offgas for 1 hour before going to the impound warehouse where they stay until shipped. He estimated the fugitive emissions to be 9 or 10 percent.

RECEIVED

AUG 26 1997

OAQPS AIR DOCKET CONTROL ROOM

CONFIRMATION *Feb 7, 1990*

DOM

RECEIVED

WRITTEN ☐
VERBAL ☐
NONE ☒

Person(s) Contacted/Title(s)

Mr. Scott Baker, Environmental Services Supervisor

He further stated that the control unit was not always in use because of maintenance and other problems with the unit. When the unit was not in use he said that the chamber was run without controls.

From: Val deOilloqui, Environmental Engineering Department

II E 360

Date of Contact: 11/3/89

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Donaldson Company, Inc. OAQPS AIR
Post Office 1299 DOCKET CONTROL ROOM
1400 West 94th Street
Minneapolis, Minnesota 55440

Telephone Number: (612) 887-3131

Person(s) Contacted/Title(s)

Cary Olson, Sales Engineer

CONFIRMATION	Feb. 7, 1990
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

CONTACT SUMMARY:

Mr. Olson was contacted regarding the 3,000 ft³/min EtO Abator™ catalytic oxidizer. He was asked about the following specifications for the unit: (1) fan size, (2) fan inlet area, (3) pressure drop across the catalyst bed, and (4) area of catalyst bed.

In response he stated that the unit used a 10 HP fan with an inlet area of 26 inches x 50 inches. He noted that the catalyst bed caused a pressure drop of 3 inches and that it had a volume of 24 inches x 40 inches x 4 inches.

From: Val deOilloqui, Environmental Engineering Department

Date of Contact: 11/13/89

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Kendall Healthcare Products Company
15 Hampshire Street
Mansfield, Massachusetts 02048

Telephone Number: (617) 423-2000

Person(s) Contacted/Title(s)

David Miller, D.V.M., Director, Scientific Services

SEARCHED	INDEXED
SERIALIZED	FILED
FEB 7 1990	
FBI - BOSTON	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Dr. Miller was contacted to follow-up on the July 1989 Section 114 information collection request (ICR). He was asked about sterilizer gas mixtures and to give the E0 use per chamber at both of their facilities. He stated that Kendall had ceased E0 use at the Bethume, South Carolina, plant and that given the type of production schedule at the Georgia Plant it would be difficult to give the E0 use per chamber. He was then asked about the type of carrier gas used at the Georgia facility and what the percentage of E0 gas to carrier gas was. He explained that carbon dioxide was used as the carrier gas and that it was a mixed ethylene oxide on site and this mixture varied from one cycle to the next. However, he said that a high concentration mix would be 15 to 16 percent E0 and that anything less than 10 percent would be considered a low concentration mix at their facility.

When asked about the controls used for the sterilizer he explained that Kendall used a recovery/reclamation system that was 60 percent efficient. He said that sterilizer gas was recovered, enriched with E0 and used for the next cycle. Kendall is working on a more efficiency recovery system at this time.

Finally, he was asked if their sterilizer chambers were equipped with rear chamber exhausts. He said that all their chambers had them and that these emissions were not recovered.

CONFIRMATION Feb 7, 1990

ROOM _____

WRITTEN ☐
VERBAL ☐
NONE ☒

From: Val deOilloqui, Environmental Engineering Department

Date of Contact: 11/20/89

AUG 26 1997

Contacted by: Telephone

Company/Agency: C. R. Bard, Inc.
731 Central Avenue
Murray Hill, New Jersey 07974

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (508) 670-4336

Person(s) Contacted/Title(s)

Bob Shaw

RECEIVED	DATE: Feb. 7, 1990
RESPONSE:	
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>	

CONTACT SUMMARY:

Mr. Shaw was contacted in order to clarify his company's response to the July 1989 Section 114 letter and to obtain a percent emission from the rear chamber exhaust. He stated that the aeration room emissions were continuously monitored using a mass spectrometer. Drain emissions were calculated using the 5 percent breakdown given by EPA's report? He explained that only the first sterilizer evacuation of each cycle to sent to the Union Carbide reclamation device capture efficiency of this unit is determined by a mass balance of what is purchased vs. E0 sent back to Union Carbide for reprocessing. The rear exhaust was estimated to emit 2 to 3 percent of the total E0 used.

Mr. Shaw explained that the three primary exhaust vents, which for the first evacuation went to the reclamation device, had a flow rate of 50 to 100 ft³/min. A number of evacuations were pulled and the rear exhaust went on for ½ hour (at a flow rate of 3,000 ft³/min) as the sterilizer was being unloaded. He said that the percentage of E0 that went out the rear exhaust was determined using the ideal gas law, using:

$$\text{Percent to rear exhaust} = \left[\frac{P_L}{P_{op}} \right] \left[\frac{P_L}{P_A} \right]^{N-1} (1-x)$$

where:

Pop = sterilizer operating pressures

PL = lowest pressure used on evacuations

PA = ambient pressure

N = No. of evacuations

x = percent of vessel filled

All pressures are absolute

He indicated that this equation was sensitive to the number of evacuations and "X" the percentage of the vessel filled. He also said EO could be substantially reduced by evacuating the chamber using very low pressures but that this was product dependent.

CONTACT REPORT--MRI Project No. 7723

From: Valentine deOilloqui, Environmental Engineering Department

Date of Contact: 12/6/89

Contacted by: Telephone

Company/Agency: Chemrox, Inc.
217 Long Hill Crossroads, Shelton, Connecticut 06484

Telephone Number: (203) 926-9081

Person(s) Contacted/Title(s)

Mr. Desai, Vice President of Sales and Marketing

RECEIVED

AUG 28 1997

CONFIRMATION	Sent 3/19/91
ROOM	
RESPONSE	4/2/91
WRITTEN <input type="checkbox"/>	
VERBAL <input checked="" type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Desai was contacted in order to obtain more information on the Hotcell™ aeration unit. He was asked for a description of the heating process the aeration unit uses and how the air is routed through the cell. He said that the unit uses any available heat source (e.g. steam, electricity) at a facility to heat the air entering the unit. Mr. Desai said that air is taken into the chamber where it is heated inside the duct. A fan then exhausts anywhere from 100-300 cfm of this air and the remainder is returned to the cell. Because more air is exhausted than returned a negative pressure is maintained inside the cell. This negative pressure ensures minimal worker exposure since air will be drawn into the cell rather than out of the cell.

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 12/11/89

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Damas Corporation OAQPS AIR
8 Romanelli Avenue DOCKET CONTROL ROOM
South Hackensack, New Jersey 07606

Telephone Number: (201) 489-0525

Person(s) Contacted/Title(s)

Mr. David Smith, President

CONTACT SUMMARY:

Mr. Smith was contacted to obtain information about the Models 25 and 50 acid-water scrubbers.

The Model 25 can handle sterilizer volumes from 4 ft³ to 100 ft³ with a cost range from \$8,000-12,000. An option to buy an automated or manual system is available. If the manual system is purchased, regeneration must be carried out manually. The automated system regenerates automatically, drains to storage tank, and monitors temperature and fan. *tanks*

Mr. Smith was asked about using the Model 25 scrubber to control emissions from hospital sterilizers. He said most large teaching hospitals have acid drains that go to neutralizing drains in the basement then to discharge. Smaller hospitals usually do not have these drains; therefore, Damas is reluctant to sell to these smaller hospitals because of liability.

If the \$8,000 unit is purchased, pressure must be controlled during discharge; the \$12,000 unit includes pressure regulator, high liquid level indicator, and fan indicator.

Damas maintains over 50 scrubbers in 13 countries with no reported failures. One of the units is at Johnson & Johnson in Tampa, Florida. Johnson & Johnson has three 1200 ft³ sterilizers which will be over 60 ft in length. Damas ships about 12 units/year.

Damas also manufactures and sells the Model 50 which can handle volumes from 100 ft³ to 500 ft³, and cost between \$10,000-20,000. Model 25 as well as Model 50 can handle explosive gases.

The following dimensions were given:

Model	Dimensions
25	30" X 5'
50	30" X 6'

[Signature] 4/1/91

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 12/18/89

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Damas
8 Romarelli Avenue
South Hackensack, New Jersey 07606
OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (201) 489-0525

Person(s) Contacted/Title(s)

Mr. David Smith, President

CONTACT SUMMARY:

Mr. Smith was contacted to clarify a couple of questions concerning the Model 25 and Model 50, E0 scrubbers and installation costs.

Mr. Smith stated that the conversion capacity of the Model 25 is 500 lb E0, and the capacity of the Model 50 is 1000lb E0.

Does 50% of capital cost for installation include contingency factor?

Only includes modifications to put system in. Does not include contingencies.

David Smith 4/1/91
7723-3.27

From: Valentine deOllouqui, Environmental Engineering Department

Date of Contact: 1/4/90

Contacted by: Telephone

Company/Agency: Baxter Healthcare Corporation
One Baxter Parkway
Deerfield, Illinois 60015

Telephone Number: (708) 948-4040

Person(s) Contacted/Title(s)

Charlie Kohlmeyer, Vice President of Corporate Facilities Engineering

RECEIVED

AUG 26 1997

OAQPS AIR

DOCKET CONTROL ROOM

CONFIDENTIAL Sent Feb 7, 1990

RESPONSE March 2, 1990

VALUATION
VOTE 1 ✓
MONITOR

CONTACT SUMMARY:

Mr. Kohlmeyer was contacted to obtain information about rear-chamber exhaust parameters. He said flow rates are dependent on sterilizer configuration and the given factor of safety a facility wishes to use to protect its' workers. He indicated that sterilizers at Baxter facilities typically have rear chamber exhaust flow rates of 1,500 ft³/min and maintain a face velocity of 50 to 100 ft/min (at the chamber door).

Mr. Kohlmeyer stated that in his opinion, the practice of holding evacuation pressures for extended periods of time to accelerate the removal of retained EO is not very effective. He said more EO could be removed from the product by increasing the number of evacuations and decreasing the pressure of these evacuations. However, he said that the ability to evacuate at lower pressures is product dependent and that not all packaging and products are able to withstand low pressures.

Mr. Kohlmeyer was then asked if a larger vacuum pump could aid in reducing the time necessary to complete evacuations and to reduce the evacuation pressure. He said that the pressure cannot be decreased faster than the product and packaging can tolerate. He stated that he has seen situations where packaging has exploded in the chamber because it could not tolerate the rapid pressure drop.

From: Valentine deOlloui, Environmental Engineering Department

Date of Contact: 1/8/90 and 1/9/90

Contacted by: Telephone

Company/Agency: Michigan Science & Engineering
Post Office Box 7105
Ann Arbor, Michigan 48107

Telephone Number: (517) 725-8184

Person(s) Contacted/Title(s)

David Hammer, Consultant to Duall Division

RECEIVED

AUG 26 1997

DOCKET CONTROL ROOM

CONFIRMATION Sent Feb 7, 1990

CONTACT SUMMARY:

Mr. Hammer was contacted to obtain more information about the Safe Cell™ Stage II control units that Duall division manufactures. He was asked the following questions:

1. What is the maximum velocity that the Safe Cell units can withstand?

Mr. Hammer replied that the Safe Cell control has a very large inlet area and that the velocity would not be a design consideration in controlling rear-chamber exhaust emissions.

2. What is the reactant changeout cost for a Safe Cell control that is controlling EO concentrations below 30 ppm?

Mr. Hammer stated that changeout costs were directly proportional to the concentration of EO sent to the control unit and that typically 30 lb of EO were captured by 100 lb of reactant. Another factor that is included in the changeout frequency is whether air is flowing through the control device continuously. He explained that air alone could contaminate the reactant and that this was the reason for suggesting the frequent changing of the reactant when the control unit is in continuous operation. He gave several changeout costs for various units to determine a rough cost of the reactant. They were \$2,500 for a control that could capture 70 to 100 lb of EO (a 400 ft³/min unit) and \$4,000 for a unit that could control 80 lb of EO (1,000 ft³/min unit).

3. Are there any Safe Cell systems made to handle flowrates of 10,000 to 20,000 ft³/min?

Mr. Hammer described a 25,000 ft³/min unit that is being designed for a facility's aeration room. The design consists of five 5,000 ft³/min control units manifolded together that comprise the larger control. He said that there was no barrier to designing the larger control units but that they became quite large and heavy (density of the reactant = 38 lb/ft³).

4. What is involved in changing the reactant bed?

He said that there are a number of control designs at this point ranging from 300 lb canisters to the larger frames that hold the solid reactant and that the easiest method of changing the reactant involves vacuuming it into 55 gallon fiber-lined drums. He also said that his company plans to recycle the reactant and that it has the capability to stockpile the reactant if necessary.

From: Sharon Srebro, Environmental Engineering Department
Date of Contact: 1/9/90
Contacted by: Telephone
Company/Agency: American Sterilizer Company, OAQPS AIR
2424 West 23rd Street, DOCKET CONTROL ROOM
Erie, Pennsylvania 16506
Telephone Number: 814-452-3100

Person(s) Contacted/Title(s)

Mr. Ralph Makinen, Manager, Chemistry and Metallurgy Research and Development

CONTACT SUMMARY:

Mr. Makinen was contacted to obtain more information on the catalytic oxidation control system that American Sterilizer (AMSCO) is developing. He said that the air ejectors that were used to evacuate the chamber were replaced with a mechanical seal vacuum pump. Several of these systems have been installed in California and one is being installed in Texas.

Mr. Makinen was then asked about sterilant gas use in the industry. He said that an EO/N2 mix (separate cylinders) has been used industrially (not hospitals) for several years. The advantage to the EO/N2 mix is that sterilization can take place at a lower EO concentration. For example, if a facility sterilized at an EO concentration of 650 mg/l with a 12/88 sterilant gas, it could sterilize with the same result at a lesser EO concentration with the EO/N2 sterilant gas. However, the sterilization cycle that the EO/N2 gas uses would require higher dwell pressures and a longer dwell time than a 12/88 cycle. He was then asked about the use of EO/CO2 as a sterilant gas. He said this gas presents two problems; it polymerizes more readily than other sterilant gases and forms more glycol.

Note: on 2/26/91 Beth Friedman and Val deHllogin decided that this telecon would not be sent out for confirmation because the information contained herein can be found in other telecons.

From: Val deOlloui, Environmental Engineering Department

Date of Contact: 12/6/89 & 1/10/90

Contacted by: Telephone

Company/Agency: Vacudyne Corporation
375 E. Joe Orr Road
Chicago Heights, Illinois 60411

Telephone Number: (312) 757-5200

Person(s) Contacted/Title(s)

Mr. Dick Matthews, Marketing and Sales Director

RECEIVED

AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONFIRMATION	Sent Feb 7, 1990
RESPONSE	
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

CONTACT SUMMARY:

Mr. Matthews was contacted to obtain vacuum pump and rear-chamber exhaust information on their sterilizers at the Sterilization Services facilities in California and Tennessee. He indicated that all of the sterilizers at the Tennessee and California facilities are equipped with rear-chamber exhausts. He explained that when the OSHA worker exposure level dropped from 50 ppm to 1 ppm Vacudyne began making the rear-chamber exhaust a standard option on the sterilizers that they manufacture. The sterilizers in Tennessee and California were retrofitted at this time.

Mr. Matthews estimated that 1 to 5 percent of the total EO charged to the sterilizer chamber is released from the rear-chamber exhaust but explained that this figure is product dependent.

He was also asked whether there were recirculating pumps on the chambers in Tennessee and California to which he replied that the pumps were either oil or closed-loop water-sealed and that there were no drain emissions.

Mr. Matthews stated that the sterilizers that Vacudyne manufacture are equipped with a standard door area but that they do build sterilizers to customer specifications. He said that the dimensions are reported in the Vacudyne sales brochure and apply to small (200 ft³) and large chambers (1,000 ft³).

CONTACT REPORT--MRI Project No. 7723

From: Ms. Sharon Srebro, Environmental Engineering Department

Date of Contact: 1/23/90

RECEIVED

Contacted by: Telephone

AUG 26 1997

Company/Agency: Damas Corporation
8 Romanelli Avenue
South Hackensack, New Jersey

OAQPS AIR
DOCKET CONTROL ROOM
07606

Telephone Number: (201) 489-0525

Person(s) Contacted/Title(s)

Mr. David Smith, President

CONTACT SUMMARY:

Mr. Smith was contacted to obtain information regarding the use of Damas scrubbers to control EO emissions from sterilizer rear chamber exhausts or from aeration rooms. He was asked if a scrubber could handle emissions from both the sterilizer vent and the rear chamber exhaust. He said that a separate control would be required to handle the rear chamber exhaust but that this separate control could also handle aeration room emissions, the only drawback being an increase in residence time. He also stated that the same liquor from the sterilizer vent scrubber could be shared with the aeration/rear chamber scrubber.

Mr. Smith stated that Damas had not yet manufactured a scrubber that could control a flow rate comparable to either the aeration or rear chamber exhaust's emission streams. However, he said that Damas was currently designing a 12,000 cfm scrubber to control a Johnson & Johnson plant's aeration room emission. Mr. Smith said that this unit will cost approximately \$80,000. Damas plans to test the efficiency of the scrubber after it has been installed (in 4-5 months).

He estimated that the cost of the 6,000 cfm scrubber would be in the \$25,000-\$35,000 range if it was used in conjunction with the sterilizer vent

scrubber. If the system were to be independent of any other control system, the cost would be roughly \$40,000-\$50,000. Installation costs would cost an additional \$5,000 for piping and 120 person-hours of labor.

He said the operating costs would be roughly the same as other Damas scrubbers that have similar ethylene glycol volumes. The amount of acid that would be required would be the same and the concentration is also the same (10 percent).

W. J. Smith 4/1/91
7723-3/34 *v*

From: Sharon Srebro, Environmental Engineering Department

Date of Contact: 1/31/90

Contacted by: Telephone

Company/Agency: Vacudyne Corporation
375 E. Joe Orr Road
Chicago Heights, Illinois 60411

Telephone Number: (312) 757-5200

Person(s) Contacted/Title(s)

Mr. Ron Greeno, Assistant General Sales Manager

CONTACT SUMMARY:

Mr. Greeno was contacted to obtain operating parameters for sterilizers as well as information regarding the use of the rear chamber exhaust. He said that when a 12/88 sterilant gas mixture is used, typical evacuation pressures may be 15 to 26 inches of mercury vacuum. Custom kits of disposable items for hospitals often contain sponges in foil; the foil packs can explode if a deep vacuum is used. Therefore, the sterilizer is usually evacuated at a higher pressure (e.g., 15 in. Hg vacuum) when custom kits are sterilized.

Mr. Greeno said that typical flow rates of emissions from the rear chamber exhaust would be 1,500 ft³/min to 3,000 ft³/min depending on chamber size. Typical flow rates (exhaust) from the vacuum system to atmosphere or a scrubber would be 100 ft³/min to 400 ft³/min depending on the size of the evacuation system.

The vacuum systems are equipped with a separator tank to handle the condensate from the humidity in the chamber. Mr. Greeno said that any EO in the overflow tank will hydrolyze to ethylene glycol. If the overflow tank becomes full, the pumps automatically send the water to another tank or to a scrubber. Mr. Greeno said that a closed-loop vacuum pump system comes with the sterilizers Vacudyne sells.

The sterilizers are designed to drawdown to pressures of 29.5 inches of mercury vacuum pure EO) and 28 inches of mercury vacuum for a 12/88 gas mixture in 30 minutes). Mr. Greeno said that Sherwood Medical has conducted studies on residual EO remaining in products.

RECEIVED

AUG 26 1997

QA/QPS AIR
DOCKET CONTROL ROOM

CONFIRMATION	Sent 3/19/91
RESPONSE	3/22/91
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

From: Sharon Srebro, Environmental Engineering
Department

RECEIVED

Date of Contact: 5/22/90

AUG 26 1997

CONFIRMATION Sent 3/19/91

Contacted by: Telephone

OAGPS AIR

DOCKET CONTROL ROOM

Company/Agency: Isomedix
1922 Exeter Road, Suite 10
Germantown, Tennessee 38138

RESPONSE

4/2/91

Telephone Number: (901) 757-4030

WRITTEN ☐VERBAL ☒NONE ☐

Person(s) Contacted/Title(s)

Pat Adams, Vice President of Eto Operations

CONTACT SUMMARY:

Mr. Adams was contacted to obtain information pertaining to rear chamber exhaust and sterilization processes at Isomedix facilities. He said that Isomedix uses the rear chamber exhaust (RCE) but not on a regular basis. The rear chamber exhaust is located in the center of the vessel (both doors open) and is uncontrolled. He indicated that the RCE will be used if the unloading of the sterilizer is manual but not necessarily if it is automatic. RCE is only used if there is a problem with the automatic conveyor and personnel must enter the room.

Mr. Adams stated that he was disappointed with the performance of Advanced Airs' gas/solid reactor. He stated that the problem with the reactor was that with high temperature the reactant contracts creating a void volume in the reactor. This allows the emissions to bypass the control altogether. When the reactant is subject to high humidity the reactant expands which has caused the reactant enclosure to split. At one point Mr. Adams stated that Lockwood Greene was hired to analyse the problem. The manufacturer replaced the PVC casing that originally came with the reactor with a steel enclosure. This enclosure also split once the reactant forcibly expanded.

The aeration process that was developed by Isomedix at the Spartanburg facility takes place in a room maintained between 120 to 130°F with a maximum temperature of 140°F depending on the product. He said that Isomedix developed this aeration process system. The air flow through the aeration room was described as 5,000 ft³/min with 400 ft³/min of this air flow being circulated through an Advanced Air Safe Cell™ Stage II control. Mr. Adams stated that Isomedix wants to keep the product warm to drive off EO while the product is still at the plant.

Sterilizer vent emissions are controlled by a John Zink flare at both the Spartanburg and El Paso Isomedix facilities. He indicated that a performance test will take place on June 11 in El Paso while the sterilizer (and flare) are operating under normal conditions.

Mr. Adams indicated that Isomedix's El Paso facility may use Seamless' old aeration controls. And that Donaldson is evaluating this upgrade.

Isomedix sterilizes with pure EO but if a product is not compatible with pure EO, a Nitrogen EO mixture is used. He said that this gas substitution requires sterilization cycle and preconditioning modifications to reduce the amount of retained EO in the product and in the chamber.



March 25, 1991

Vallentine V. deolloqui
Ass't Environmental Engineer
Midwest Research Institute
Suite 350
401 Harrison Oaks Blvd.
Cary, North Carolina 27513

Dear Ms. V. deolloqui:

Enclosed is the contact report you forwarded for a 5/22/90 phone discussion between Sharon Srebro and myself. I have made a few minor changes and am also including a summary of the performance test results on the flare. The minimum calibration acceptance on the GC was 5 ppm so all "no readings" were calculated as if they were 5 ppm. Also for your information we are replacing our Safe cell II's with Donaldson catalytic scrubbers which will scrub the aerations cells, sterilizer room, and chamber hood vents. We could not use the Seamless equipment mentioned in Sharon's report because it was too small.

If I can be of any further assistance, please let me know.

Sincerely,

Patterson Adams
V.P. EtO Operations

ISOMEDIX INC.

From: Valentine deOlloui, Environmental Engineering Department

Date of Contact: 5/31/90

Contacted by: Telephone

Company/Agency: Griffith Microscience Inc.
7775 Quincy Street
Willowbrook, Illinois 60521

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

Telephone Number: (708) 325-6999

Person(s) Contacted/Title(s)

Mr. William Fitzgerald

CONTACT SUMMARY:

Mr. Fitzgerald was contacted in order to obtain a test report on a Chemrox scrubber that Griffith Microscience uses to control Hot Cell™ aeration emissions. He explained that the report was done by an independent testing company and that the results showed a 99.96 percent EO removal efficiency. He said that the EO concentration going to the scrubber was measured only once while the testing was taking place. This concentration was used as an average to determine the amount of EO sent to the scrubber. For this reason, Mr. Fitzgerald doubted the authenticity of the testing procedure because the EO offgassing rate from a product is not constant but is best described as an exponential function. Therefore, dependent on when the emission stream sample was taken during the aeration process, this method could bias the results high or low.

He mentioned that a better solution to controlling ^{or reducing} emissions from the rear chamber exhaust might be to modify the sterilization process. Prior to opening the sterilizer door (and activating the rear chamber exhaust), air could be removed from the sterilizer head space using a bleed valve; the vacuum pump could remove this air. He said that this practice would result in the removal of most of the EO that remains in the sterilizer void volume.

This EO would be processed through the emission control system.

After the chamber head space has been evacuated the rear chamber exhaust could be activated to protect workers while ~~loading and~~^{loading} unloading the chamber. Since most of the EO would be removed during the head space evacuation the rear chamber exhaust EO emissions would be minimized. He maintained that the banning of the rear chamber exhaust would not be a viable control alternative because it is necessary to minimize worker exposure. Also, if controls were required for the rear chamber exhaust some facilities may not use rear chamber exhausts and therefore create a worker exposure problem.

In regard to controlling aeration room emissions, Mr. Fitz^Ggerald said that he plans to use catalytic oxidation. He said that scrubbers are being used to control aeration ^{Hot cell} ~~room~~ emissions at ^{one} ~~a couple~~ of their facilities, ~~but~~
~~due to their enormous size and relatively long residence times (in the packed tower)~~ ^{this plant} Griffith Micro^SScience will switch to catalytic oxidation controls. In conclusion, Mr. Fitz^Ggerald said that he does not believe that acid/water scrubbers are feasible for controlling aeration room emissions ^{to an efficiency of 99% EO removal,} but are applicable to sterilizer vent emissions.

Corrected

4/7/91

[Signature]

CONTACT REPORT -- MRI PROJECT NO. 7723

RECEIVED

From: Valentine V. deOllolqui

AUG 26 1997

Date of Contact: 8/30/90

Contacted by: Telephone

OAQPS AIR
DOCKET CONTROL ROOMCompany/Agency: Damas
8 Romanelli Ave.
South Hackensack, NJ 07606

Telephone Number: (201) 489-0525

Person Contacted/Title:
Mr. David Smith/President

=====VO

CONTACT SUMMARY:

Mr. Smith was contacted to determine whether a 3000 cfm acid-water scrubber designed to control rear chamber exhaust emissions at an efficiency of 99 percent could be used to control sterilizer vent emissions, which have a higher concentration and lower flow rate. He said that the same control device could not be used to control sterilizer vent emissions. The reason for this is that there are different design considerations for each emission stream. Because of the high flow rate of the rear chamber exhaust emission stream a control would have to be quite large to provide adequate residence time to allow the EO to react with the acid-water solution. There would also have to be an increased number of tubes at the base of the tower to break up the large gas stream entering the control. Therefore, the costs of the rear chamber exhaust control would be quite exorbitant.

Mr. Smith said that a two-stage system is being developed that could control both types of emission streams: high flow, low concentration and low flow, high concentration. He said that two individual controls specifically designed for each emission stream would be the best control alternative.


4/1/91

** Send revised Copy*

A-88-03

CONTACT REPORT--MRI Project No. 7723-4

II E 376

From: Valentine V. deOllolqui, Environmental Engineering Department

Date of Contact: 10/11/90

RECEIVED

Contacted by: Telephone

AUG 2 1991 INFORMATION sent 3/19/91

Company/Agency: Chemrox Inc. 217 Long Hill Shelton, Connecticut 06484
OAGPS AIR CONTROL ROOM

Telephone Number: (203) 926-9081

Person(s) Contacted/Title(s)

Pankaj Desai

CONTACT SUMMARY:

Mr. Desai was contacted to obtain information regarding the acid-water scrubber Chemrox manufactures. He was asked what the maximum specific gravity of the scrubbing liquor could be before the control efficiency began to decrease. Mr. Desai explained that most of the scrubbers Chemrox manufactured a year ago were designed for a maximum ethylene glycol concentration of 40% (w/w). However, lately facilities are requesting scrubbers that are designed to operate at a maximum ethylene glycol concentration of 70% (w/w). The differences between these two scrubbers are design parameters such as the size of the tower, height of packing, and flowrate of liquid to the top of the tower. The study used to establish the basis for the scrubber efficiency at the design ethylene glycol concentrations given was an in-house study used to establish the basis for the scrubber efficiency at the design ethylene glycol concentration given was an in-house study performed by Chemrox entitled Effect of Viscosity on EO Removal.

Mr. Desai was also asked if there was a gauge on the scrubber to determine when the ethylene glycol had reached the maximum concentration. He explained that once all the acid-water solution had reacted (at maximum design concentration of ethylene glycol) the tank would be full and the scrubber would be unable to operate. The operator would be notified of the need to change the tank by a level on the side of the tank. If the level on the tank is ignored, a light on the side of the control panel comes on, indicating a need to change the contents of the tank. If the light is also ignored, the scrubber will operate for two more weeks before it shuts itself down when it has reached the maximum design concentration.

Mr. Desai was also asked how many sterilizer evacuations were typically performed by facilities. He said that three

evacuations were typical and that the depth of these evacuation
~~is dependent on the purpose of the evacuation.~~

CONTACT REPORT -- MRI PROJECT NO. 377

RECEIVED

AUG 28 1997

OAGPS AIR
DOCKET CONTROL ROOM

From: Valentine V. deOlloqui
Date of Contact: 10/11/90
Contacted by: Telephone
Company/Agency: Damas
8 Romanelli Ave
South Hackensack, NJ 07606
Telephone Number: (201) 489-0525

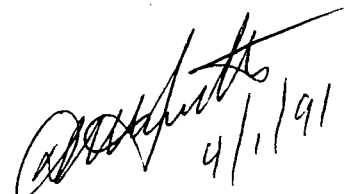
Person Contacted/Title:

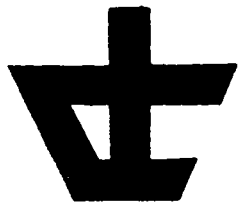
Mr. David Smith/President

=====VO
CONTACT SUMMARY:

Mr. Smith was contacted to obtain information regarding the changeout of scrubbing liquor in the Damas scrubber. He said that Damas recommends changing the scrubbing liquor once it has reached an ethylene glycol concentration of 60 % (w/w). This ethylene glycol concentration is a conservative estimate based on laboratory and customer tests that showed a decrease in EO removal efficiency at 80% and 75% (w/w) ethylene glycol, respectively. Mr. Smith said that no facilities have reported decreased control efficiencies operating the scrubber with an ethylene glycol concentration of up to 60 % (w/w).

Mr. Smith was also asked what methods were typically used to indicate that the scrubbing liquor had reached the maximum ethylene glycol concentration. He said that if a facility was using a set amount of EO per day, the changeout period could be determined based on usage. Otherwise, the changeout period could be closely approximated on EO use, and the ethylene glycol concentration monitored with a hydrometer to determine changeout.





damas

corporation

8 ROMANELLI AVE.
SO. HACKENSACK, NJ 07606
(201) 489-0525
FAX (201) 489-6320

April 1, 1991

Midwest Research Institute
Suite 350
401 Harrison Oaks Blvd.
Cary, North Carolina 27513
Attn: Valentine V. deOlloqui

RECEIVED APR - 4 1991

Dear Mr. deOlloqui:

Regarding your letter of March 14, 1991, I have signed all the necessary contact reports that you sent me and I am returning them to you. All the reports are accurate and complete.

If you should have any questions or problems please don't hesitate to contact me at 201-489-0525.

Sincerely,

David M. Smith
President

DMS/sw
Enclosures

Final vol. of solution (excluding acid) = n

@ 60% saturation : EG volume = .6*n

H₂O volume = .4*n

1) 18 gal of H₂O repl. 37.9 gal of EG

Original vol. of H₂O fully conv. to EG = $\frac{0.6*n*18}{37.9}$

H₂O molecular wt. = 18

EO molecular wt. = 44

EG molecular wt. = 62

K = original volume of water = H₂O fully converted to EG + H₂O unused

$$K = \frac{0.6*n*18}{37.9} + 0.4*n = 0.685*n$$

$$n = K * 1.46$$

for K=750 gal @ 60% saturation n = 1.46*750 = 1,100 gal of liquid

Final volume of EG = 0.6*n = 660 gal


$$44 \text{ lbs EO} \longrightarrow 62 \text{ lbs EG} \xrightarrow{9.28 \text{ lbs/gal}} 6.68 \text{ gal EG} \xrightarrow{1)} 3.17 \text{ gal of liquid}$$

660 gal of EG = 6,125 lbs of EG \longrightarrow 8,636 lbs of EO

For 2 tanks multiply by 2

for 336 lbs/ day = 17,270 lbs EO / 336 = 51 days

CATS

 damas corp.	
DATE	TIME
0-24-1980	4:00 P.M.
Registration OUT SOLUTION	
270004V	

From: Valentine V. deOlloqui, Environmental
Engineering Department

Date of Contact: 10/14/90

Contacted by: Telephone

Company/Agency: Baxter Healthcare Corporation
One Baxter Parkway
Deerfield, Illinois 60015

Telephone Number: (708) 948-4040

Person(s) Contacted/Title(s)

Mr. Charlie Kohlmeyer/Vice President of Corporate Facilities
Engineering

CONTACT REPORT:

Mr. Klohmeier was contacted to obtain information on
sterilizer operating parameters. The conversation is summarized
below:

1. How many evacuation are typically done to remove EO from
the product and chamber? Anywhere from 2 to 6 evacuations. This
is a function of both the product and the depth of the vacuum
drawn during evacuation. A pure EO cycle may evacuate the
chamber down to 2 to 3 inches of mercury whereas a 12/88 cycle
may only evacuate the chamber down to 1/3 to 1/2 atmospheric
pressure.

2. How much moisture is in the sterilizer during the
sterilization cycle? The amount of steam added to the chamber
varies, but usually a relative humidity of 50 to 60 percent is
desired.

RECEIVED

AUG 23 1997

INFORMATION Sent 3/19/91	
OACPS AIR	April 2, 1991
DOCKET CONTROL ROOM	
WRITTEN <input type="checkbox"/>	
VERBAL <input checked="" type="checkbox"/>	
NONE <input type="checkbox"/>	

RECEIVED

AUG 28 1991

DOCKET CONTROL ROOM

CONFIRMATION

sent 3/19/91

A-88-03

RESPONSE

II E 379

WRITTEN ☐

VERBAL ☐

NONE ☒

CONTACT REPORT -- MRI PROJECT NO. 7723

From: Valentine V. deOlloqui
Date of Contact: 10/14/90
Contacted by: Telephone
Company/Agency: Johnson & Johnson Healthcare Products
1 J&J Plaza
New Brunswick, NJ 08933
Telephone Number: (201) 874-1852

Person Contacted/Title:

Mr. Miron Popesque

=====VO

CONTACT SUMMARY:

Mr. Popesque was contacted to discuss sterilizer operating parameters. The following is a summary of that conversation;

(1.) How many evacuations are typically performed to remove EO from the chamber and the product? Anywhere from 1 to 5 evacuations are performed depending on the product density when 12/88 sterilant gas is used.

(2.) How would you describe an evacuation? The essence of an evacuation is the substitution of environments. In a pure EO cycle EO is being substituted with fresh air using either ejectors or a vacuum pump.

(3.) What sterilant gases are currently being used and is 10/90 gas commonly used? Most facilities are switching to either pure EO or EO with a nitrogen purge. The 10/90 gas is not used much because it is hard to predict the EO concentration because the gases separate at the supply cylinder due to the higher vapor pressure of the carbon dioxide.

(4.) At what capacity is the sterilization chamber typically operated? One hundred percent capacity.

A-88-03

CONTACT REPORT--MRI Project No. 7723

II E 380

From: Valentine V. deOliveira, Environmental
Engineering Department

Date of Contact: 10/17/90

AUG 26 1997

Contacted by: Telephone

Company/Agency: Linde Division of Union Carbide
100 Davidson Avenue
Post Office Box 6744
Somerset, NJ 08873

Telephone Number: (201) 271-2618

Person(s) Contacted/Title(s)

Mr. Chip Woltz

DOCKET CONTROL ROOM	
CONFIRMATION	sent 3/19/91
RESPONSE	3/22/91
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

CONTACT SUMMARY:

Mr. Chip Woltz was contacted to discuss sterilant gas use among sterilization facilities. He said that due to the increased cost of CFC's, the use of 12/88 sterilant gas is on the decline. Many larger contract sterilizers, pharmaceuticals, and medical equipment suppliers are either (1) going to pure EO or EO/N2 cycles (which requires them to modify their facilities to make them explosion-proof); (2) recovering the 12/88 gas for reuse; (3) using radiation for sterilizing (if possible); or (4) using a contract sterilizer. He said that he expects 12/88 use to cease by the mid 1990's. By this time, there would be a "drop-in" HFC substitute for CFC's. He said that the larger facilities are actively investigating alternatives to 12/88 gas. Primarily hospitals and facilities that use only small amounts of 12/88 are waiting for a drop-in substitute.

Mr. Woltz said that facilities that plan to continue to sterilize products in-house with EO/N2 will have to explosion-proof their facilities or construct new facilities because it will house pure EO. There is also an additional cost for facilities that choose to sterilize (in-house or out-of-house) their product with EO/N2: the cost of revalidating the sterilization cycle for the products they plan to sterilize with EO/N2.

Nitrogen is used along with the ethylene oxide to reduce the possibility of an explosive gas mixture existing inside the sterilization chamber. Nitrogen has an added benefit of giving the operator flexibility in the design of sterilization cycles. For instance, traditional pure EO cycles require very deep vacuums (i.e., 29 in/Hg) in order to remove all air from the chamber initially, and all EO from the chamber after exposure. Such deep vacuums can sometimes damage pressure sensitive devices or packaging. Using nitrogen as a purge gas allows great

flexibility in cycle design, since nitrogen purging cycles can be designed to fit virtually any product/package combination.

From: Valentine V. deOlloui, Environmental Engineering Department

Date of Contract: 10/23/90

Contacted by: Telephone

Company/Agency: Griffith Micro^SScience
7775 Quincy Street
Willowbrook, Illinois 60521

Telephone Number: (708) 325-6999

Person(s) Contacted/Title(s)

Mr. William Fitz^Ggerald

FITZGERALD

CONTACT SUMMARY:

Mr. Fitz^Ggerald was contacted to obtain typical operating parameters for an EO/N₂ cycle. He said that the operating parameters for these cycles vary according to the product to be sterilized, but that the product is sterilized just below atmospheric pressure. He said that an amount of steam equivalent to a pressure increase of 1 inch of mercury is added to the chamber prior to the purging of the chamber with nitrogen. He gave the following example of the typical EO/N₂ cycle.

injecting
Evacuate the chamber to 16" HG, and purge air from the chamber by drawing nitrogen into the chamber up to a pressure of 50" HG; then evacuate the chamber down to 16" HG again. This step is repeated twice. Then an amount of steam is added that will give a pressure increase of 1" HG. After the addition of steam, EO is added to the chamber over time (about an hour) until a dwell pressure of 29" HG is reached. The product is then held at the dwell pressure for some specified time. The chamber is then evacuated by allowing the chamber pressure to return to atmospheric. *approximately*

Mr. Fitzgerald said that the effect of the evacuation on the removal of EO was different for each cycle depending on the pressures used to evacuate the chamber and the concentration of EO in the chamber during the dwell period. Because a lower initial vacuum can be drawn on a pure EO cycle, a higher EO concentration will result in the chamber. For this reason, a typical pure EO cycle may sterilize at an EO concentration of 800 mg/l whereas a 12/88 cycle may only sterilize at half that concentration. *can*

The rear chamber exhaust (back draft valve) at Griffith Microscience is used primarily to flush nitrogen from the chamber headspace. Mr. Fitz^Ggerald said that given a 1340 ft³ chamber, 400 ft³ of that chamber (once it's loaded with product) may be

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GRIFFITH MICRO SCIENCE
AUG 2 1997
OAGPS AIR
BUCKET CONTROL ROOM

100 head space which will contain EO and N2 after the cycle is finished. If a 3000 cfm blower is used for the rear chamber exhaust, it may take ~~a little over~~ a minute to clear the headspace of EO and N2. Clearing this headspace is necessary to prevent worker asphyxiation during the unloading of the chamber, as well as to minimize worker exposure to EO. He said that some facilities that do not have rear chamber exhausts, ~~open an air~~ in-bleed valve while the vacuum pump is running to remove EO/N2 from the chamber headspace. *less than* *may*

Mr. Fitzgerald said that many newer facilities are using conveyors or other automated means to unload the sterilizer. Also, Griffith Microscience plans to put catalytic oxidizers on their rear chamber exhaust and their aeration processes.

Correction

4-7-91

W Fitzgerald

IDENTICAL LETTERS SENT TO 42 INDIVIDUALS (LIST ATTACHED TO OFFICIAL FILE)

December 14, 1990

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AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOM

NOTICE OF MEETING

The United States Environmental Protection Agency's (EPA) National Air Pollution Control Techniques Advisory Committee (NAPCTAC) will meet on January 29, 30, and 31, 1990 to review the subjects shown on the enclosed agenda. The meeting will be held at the Sheraton Imperial Hotel and Convention Center in Research Triangle Park, North Carolina. A copy of the NAPCTAC roster is also enclosed for your information.

The NAPCTAC meetings are always open to the public, and you are invited to attend and participate in the discussions. Ethylene oxide commercial sterilizers will be regulated under the authority of Title III of the amended Clean Air Act. The background information associated with the control of commercial ethylene oxide sterilization facilities is described in the enclosed executive summary which will be discussed at the meeting. The meeting will be announced in the Federal Register, but we wanted you to have this information because of your interest in this subject.

In order to properly plan the meeting, it is necessary for me to know prior to the meeting if you plan to make a presentation. Please call Ms. Mary Jane Clark at (919) 541-5571 by January 22 if you would like to make a presentation. If you do plan a presentation, please bring a copy of it to the meeting for our use in preparing the meeting minutes. If you wish to distribute your presentation to the Committee and staff, 25 copies will be sufficient. Written comments are certainly welcome, and we can schedule a meeting with your association to discuss your comments if you so desire.

For your information, a block of rooms (special rate of \$60 a day) is being held at the Sheraton until January 14 for use by those who wish to stay where the meeting is being held. When you make your reservations, please indicate that you will be attending the EPA meeting. The telephone number is (919) 941-5050. The Sheraton does provide a courtesy airport limousine.

Sincerely,

/s/

James B. Weigold
Acting Director
Emission Standards Division

3 Enclosures

OAQPS:ESD:OD:MJClark:mjclark, rm 1105, NCM, x5571 (MD-13): 12/13/90

bcc: Dave Markwordt ESD/CPB

TENTATIVE AGENDA

U. S. ENVIRONMENTAL PROTECTION AGENCY

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Sheraton Imperial Hotel and Convention Center
Empire Rooms I, II, and III
I-40 Exit 282 at Page Road
Research Triangle Park, North Carolina 27709
(919) 941-5050

JANUARY 29, 30, AND 31, 1991

January 29 (Tuesday) - 9:00 a.m.

OVERVIEW OF TITLE III CLEAN AIR ACT AMENDMENTS
Summary of Title III Requirements for Hazardous Air Pollutants

DEFINITION OF SOURCE
Discussion of Alternative Definitions of "Source" and
Implementation of Title III Provisions

PETITION PROCESS
Status Report on the Development of Guidance for Petitions to Add or Delete
Compounds from the List of Hazardous Air Pollutants
(Title III of the Clean Air Act Amendments)

SOURCE CATEGORY LIST
Status Report on the Development of a List of Source Categories That Emit
the 189 Hazardous Air Pollutants in the Amendments
(Title III of the Clean Air Act Amendments)

EARLY EMISSION REDUCTION
Status Report on Implementation of the Title III Provisions for Early Reductions
to Defer Application of Maximum Achievable Control Technology (MACT)
(Title III of the Clean Air Act Amendments)

A LUNCH BREAK WILL BE TAKEN FROM 1:00-2:00 P.M. EACH DAY

U.S. ENVIRONMENTAL PROTECTION AGENCY

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Chairperson and Designated Federal Official

Director, Emission Standards Division (MD-13)
Office of Air Quality Planning and Standards
U. S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

(919) 541-5572
FTS: 629-5572

COMMITTEE MEMBERS

Mr. Paul H. Arbesman*
Director, Pollution Control
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Columbia Road and Park Avenue
Morristown, New Jersey 07962
(201) 455-4286

Mr. James A. Martin
President
Environmental Systems Division
Asea Brown Boveri, Inc.
Post Office Box 43030
Birmingham, Alabama 35243
(205) 991-2832

Mr. Donald R. Arkel
Director
Lane Regional Air Pollution Authority
225 North 5th Street-Suite 501
Springfield, Oregon 97477
(503) 726-2514

Ms. Vivian M. McIntire
Environmental Affairs
Eastman Chemicals Company
Post Office Box 511
Kingsport, Tennessee 37662
(615) 229-3045

Dr. Patrick R. Atkins
Director, Environmental Control
Aluminum Company of America
1501 Alcoa Building
Pittsburgh, Pennsylvania 15219
(412) 553-3805

Mr. William O'Sullivan*
Assistant Director
Air Quality Engineering and Technology
N.J. Department of Environmental Protection
401 East State Street, CN027
Trenton, New Jersey 08625
(609) 984-6721

Mr. Charles A. Collins*
Administrator, Air Quality Division
Wyoming Department of
Environmental Quality
122 West 25th Street
Cheyenne, Wyoming 82002
(307) 777-7391

Dr. John E. Pinkerton*
Program Director, Air Quality
National Council of the Paper Industry
for Air and Stream Improvement, Inc.
260 Madison Avenue
New York, New York 10016
(212) 532-9047

Mr. William J. Dennison*
Director of Engineering
South Coast Air Quality
Management District
9150 Flair Drive
El Monte, California 91731
(818) 572-6209

Ms. Deborah A. Sheiman
Resource Specialist
Natural Resources Defense Council
1350 New York Avenue, N.W.-Suite 300
Washington, D. C. 20005
(202) 783-7800

Mr. Ralph E. Hise*
President
Advanced Technologies Management, Inc.
2964 Falmouth Road
Cleveland, Ohio 44122
(216) 751-5135

*New Member

December 1990

Ethylene Oxide Sterilization Facilities (42)

no, name1

1.

✓ Mr. Pankajh Desai
Vice-President
Chemrox, Inc.
217 Long Hill Crossroads
Shelton, Connecticut 06484

2.

✓ Mr. Dick Matthews
Director, Sales and Marketing
Vacudyne Corp.
375 E. Joe Orr Road
Chicago Heights, Illinois 60411

3.

✓ Mr. Chip Woltz
Product Manager
Union Carbide
Linde Division
Post Office Box 6744
Somerset, New Jersey 08873

4.

✓ Mr. James F. Jorkasky
Health Industry Manufacturers
Association (HIMA)
1030 Fifteenth Street, N.W.
Washington, D.C. 20005-1598

5.

✓ Mr. Thomas X. White
Pharmaceutical Manufacturers
Association
1100 Fifteenth Street, N.W.
Washington, D.C. 20005

6.

✓ Mr. Bill Bunnell
American Library Association
50 E. Huron Street
Chicago, Illinois 60611-2729

7.

✓ Dr. Carol M. McCarthy, Ph.D.
President
American Hospital Association
840 North Lake Shore Drive
Chicago, Illinois 60611

8.

✓ Dr. James H. Saramons, M.D.
Executive Vice President
American Medical Association
535 North Dearborn Street
Chicago, Illinois 60610-4377

9.

✓ Mr. Thomas F. Burns
Executive Vice President
American Spice Trade Association
Post Office Box 1267
Englewood Cliffs, New Jersey 07632

10.

✓ Mr. Thomas Ronca
Vice President, Quality Assurance
and Regulatory Affairs
Burron Medical, Inc.
904 Postal Road
Allentown, Pennsylvania 18104

11.

✓ Mr. Harry Johantgen
Senior Project Coordinator of
Ethylene Oxide Sterilization
Ethicon, Inc.
Route 22
Somerville, New Jersey 08876

12.

✓ Mr. Gary Meyer
Valleylab, Inc.
5920 Longbow Drive
Boulder, Colorado 80301

13.

✓ Mr. David Smith
President
Damas Corp.
8 Romanelli Avenue
South Hackensack, New Jersey 07606

14.

✓ Mr. M. G. Popescu
Technical Advisor
Johnson and Johnson International
One Johnson and Johnson Plaza
New Brunswick, New Jersey 08933

15.
✓ Mr. John Kjellstrand
Vice President of Technical
Micro-Biotrol, Inc.
2973 Olympic Industrial Boulevard
Smyrna, Georgia 30080

16.
✓ Mr. Joseph B. Peters
Technical Sales Manager,
Industrial Sterilizers
Environmental Tectonics Corp.
County Line Industrial Park
Southampton, Pennsylvania 18966

17.
✓ Ms. Joyce Chandler
DC Environmental Control
50101 Overlook Avenue, S.W.
Washington, D.C. 20032

18.
✓ Mr. Mike Stenburg
Air Management Division
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II E 383

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Date of Contact: 12/19/90 and 12/13/90

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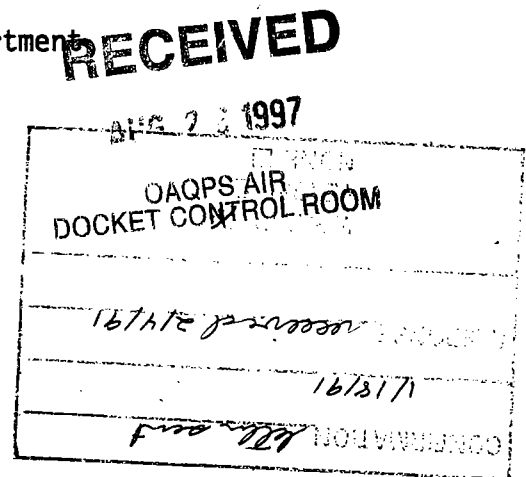
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Person(s) Contacted/Title(s)

Tony Rierson, Engineering Manager

Lee Cutright, Director Quality and Regular Affairs



CONTACT SUMMARY:

I called the company to obtain additional information about the factors affecting the probable ethylene oxide (EO) concentration levels in the aeration room.

Mr. Cutright said that the company has no data on the amount of EO that is retained on products at the time they are brought into the aeration room. His estimate of 30 percent EO from earlier conversations with EPA/MRI is just an educated guess. The only data they have are the EO retention levels on products 2 to 3 days after they have been aerated. These data are obtained by sending products to an outside lab, Microbiology Consulting in Huntington, West Virginia, who tests EO levels to insure they meet FDA proposed rules for EO level, however they are normally less than 5 ppm.

Previously aeration took 3 to 5 days. Now that they heat the aeration room air to 125°F and change the room air 13 times per hour, aeration only takes 24 hours. Employees wear masks while they are in the aeration room, but they are only supposed to be in the room long enough to load and unload product. Mr. Rierson said that the facility meets the OSHA excursion level and stays within the action level range. Any additional reductions to worker exposure would require the plant to automate the transportation of product from the sterilizer chamber to the aeration room. In order to avoid the high capital cost of installing an automated system, the company plans to send their product to a contract sterilizer, Isomedix, in the near future.

Both Mr. Rierson and Mr. Cutright said that some products are more likely to retain higher amounts of EO, e.g., latex, PVC, gauze, and vinyl products. Mr. Cutright said that approximately 20 percent of their sterilizer loads contain these materials. These materials are commonly used in medical products and are probably sterilized by a wide variety of the industry, according to Mr. Rierson. Mr. Cutright noted that some facilities are more single-product oriented and may sterilize only gauze bandages, for example.

The company installed the Donaldson/MSA catalytic incinerator to demonstrate to the State that they could comply with the State's 1 ppm standard at 50 feet from the fence line. The control device was sized based on flowrates (not probable concentrations).

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**OAQPS AIR
DOCKET CONTROL ROOM**

National Air Pollution Control Techniques Advisory Committee

Minutes of Meeting

January 29-31, 1991

**U. S. Environmental Protection Agency
Emission Standards Division (MD-13)
Office of Air Quality Planning and Standards
Office of Air and Radiation
Research Triangle Park, North Carolina 27711**

ERRATA

Errata for discussion that followed a presentation by Mr. William Fisher, Vice President, International Fabricare Institute at a meeting of the NAPCTAC held January 29-31, 1991.

On page 161, please replace the second sentence of the second full paragraph with the following sentence: "He stated that a consistent definition of generally available control technology (GACT) is not found in the CAA Conference report, but consistent definitions are in both the House and Senate reports."

On page 162, the first sentence of the third paragraph should read as follows: "Mr. Fisher estimated the amount of PCE contained in separator water to be on the order of 0.6 ounces per year for a dry cleaning machine without a carbon adsorber that generates about 50 gallons of separator water per year."

On page 162, the last sentence of the fourth paragraph should read as follows: "He remarked that this cost of recovery would be quite high."

On page 162, the last sentence on the page should read as follows: "He mentioned that Mr. William Seitz, of the Neighborhood Cleaners Association, represented retail launderers and, together, the two trade associations had a combined membership of 12,000 to 15,000."

On page 163, the following sentence should be added to the end of the first paragraph that was continued from the previous page: "He stated that the Coin Launderers Association represents the coin-operated sector."

On page 163, the final paragraph should read as follows: "Mr. Weigold asked whether affordability should be a criterion for establishing MACT. Mr. Fisher responded that EPA had the ability and several examples provided by Congress and EPA should be looking at GACT, rather than a MACT/BACT type standard. Mr. Fisher stated that if one's looking voluntarily at MACT, then his answer would be yes, affordability should be a criterion."

U.S. ENVIRONMENTAL PROTECTION AGENCY

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

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January 1991

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I. INTRODUCTION AND COMMENTS

Mr. James B. Weigold, Chairperson
National Air Pollution Control Techniques
Advisory Committee

The National Air Pollution Control Techniques Advisory Committee (NAPCTAC) held a meeting on January 29-31, 1991, at the Sheraton Imperial Hotel and Convention Center in Research Triangle Park, North Carolina. Acting Chairperson James B. Weigold called the meeting to order at 9:00 a.m. Committee members in attendance were: Mr. Paul H. Arbesman, Mr. Donald R. Arkell, Dr. Patrick R. Atkins, Mr. Charles A. Collins, Mr. William J. Dennison, Mr. Ralph E. Hise, Ms. Vivian M. McIntire, Mr. William O'Sullivan, Dr. John E. Pinkerton, and Ms. Deborah A. Sheiman. Mr. James R. Martin was unable to attend the meeting.

The EPA attendees and participants in the meeting included the following employees:

Amanda Agnew	Dave Guinnup	Anne Pope
Doug Bell	Bill Harnett	Bob Rosensteel
Jim Berry	Kaye Harris	Sims Roy
Karen Blanchard	Fred Hauchman	Mohamed Serageldin
Dianne Byrne	K.C. Hustvedt	Beth Hassett-Sipple
Karen Catlett	Mike Johnston	Andy Smith
Linda Chaput	Wayne Kasier	Gene Smith
Alice Chow	Kathy Kaufman	Tim Smith
Mary Jane Clark	Martha Keating	Candace Sorrell
Frank Clay	Bob Kellam	Marty Spitzer
Rick Copland	James Kilgroe	Debbie Stackhouse
Rick Colyer	Gail Lacy	Walt Stevenson
Eric Crump	Tom Lahre	Madeline Strum
Jim Crowder	Elaine Manning	David Svendsgaard
Fred Dimmick	Dave Markwordt	John Vandenberg
Rima Dishakjian	James Maysilles	Amy Vasu
Michele Dubow	Ed McCarley	Lynn Vendirello
Ellen Ducey	Jan Meyer	Al Vervaert
Ken Durkee	Deborah Michelitsch	Melissa Watkins
Mike Dusetzina	Tim Mohin	Tim Watkins
Leslie Evans	Bruce Moore	Al Wehe
Joe Freedman	Andrew Otis	Jim Weigold
Judy Graham	Lee Page	Gil Wood
	Nancy Pate	Susan Wyatt

The agenda for the meeting was published in the Federal Register on January 11, 1991.

Mr. Weigold opened the meeting by extending a welcome on behalf of EPA and then introduced his colleagues at the speakers table; the EPA and EPA contractor staffs on hand to answer technical, economic, and regulatory questions; and the EPA staff handling the administrative aspects of the meeting. He asked that everyone sign the official register to provide a record of their participation in the meeting. Mr. Weigold noted that minutes of the proceedings would be available approximately 1 month after the date of the meeting.

Mr. Weigold briefly outlined the agenda and then introduced Mr. Bill Harnett, who presented an overview of Title III Clean Air Act Amendments. Some 30 speakers representing EPA and industry addressed issues concerning air pollution to the Committee.

II. Overview of Title III of the Clean Air Act Amendments of 1990

EPA PRESENTATION

Mr. William Harnett
Emission Standards Division
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

SUMMARY

Title III, "Hazardous Air Pollutants," represents a complete overhaul of the previous Section 112 of the Clean Air Act. It also represents a change in philosophy of how air toxics should be controlled. To start with, in the last 20 years under the previous Section 112, EPA had listed 8 pollutants as hazardous air pollutants. The new Section 112 automatically listed 189 hazardous air pollutants. There is also a process for people to petition EPA to add or delete pollutants. By November 1991, EPA is required to publish a list of all of the categories of major sources and significant area sources which emit these pollutants. A major source is defined as a source which emits 10 tons per year or more of any one listed pollutant or 25 tons per year or more of any combination of listed pollutants. By November 1992, EPA is required to publish a schedule for regulating all of the listed source categories. The amendments required EPA to regulate 40 source categories and coke ovens within 2 years, 25 percent of the source category list within 4 years, 50 percent within 7 years, and 100 percent within 10 years. If EPA fails to issue a MACT standards for an industry on schedule, sources within that industry must apply for operating permits which would comply with MACT levels within 18 months. The EPA or a State with an approved permit program would decide on these levels on a case by case basis.

The standards EPA is to develop are to be based on the maximum achievable control technology (MACT). For new sources, the standards are to be no less stringent than the best controlled similar source. For existing sources, the standards are to be no less stringent than the average of the top 12 percent in terms of emissions reduction of existing sources. EPA is allowed to exclude sources which recently installed lowest achievable emission reduction (LAER) controls in calculating the top 12 percent. These levels are floors. The EPA has the authority to set more stringent standards. The early MACT standards will address coke ovens, the chemical manufacturing industry, dry cleaning, dry cleaners, chromium electroplaters, commercial sterilizers, and asbestos sources. Other source categories EPA is working on are petroleum refining, iron and steel production, pulp and paper mills, bulk terminals, polymers and resins, wood furniture manufacturing, magnetic tape manufacturing, and industries with surface coating operations.

The schedule for compliance with the MACT standards is 3 years with the possibility of a 1 year extension on a case by case basis. Those plants which have recently installed controls to comply with best available control technology or LAER determinations are allowed up to 5 years from when those controls were installed before they must comply with MACT standards. Plants which achieve a 90 percent (95 percent for toxics which are particulate matter) reduction in their air toxic emissions prior to proposal of the MACT standards are given a 6 year extension from complying with MACT standards.

The amendments require EPA to review the residual health risk associated with the emissions remaining after application of MACT standards. If the maximum individual risk of cancer exceeds 1 in 1 million for carcinogens or fails to provide an "ample margin of safety" for noncarcinogens, EPA is required to promulgate additional standards to provide further health protection. Sources will have to comply with these standards within 90 days or at a maximum 2 years.

Section 129 of Title III requires EPA to set MACT standards for new solid waste combustors and emission guidelines based on MACT for existing combustors including individual limits for a specific list of pollutants. The EPA is to develop standards for large municipal waste combustors (MWC) within 1 year of enactment, small MWC's and medical waste incinerators within 2 years, and commercial and industrial solid waste combustors within 4 years.

Included in the new Section 112 is a specific provision for modifications. New sources and those existing sources which modify their facilities and have an increase in their emissions of listed pollutants above a de minimis amount must install MACT even if EPA has not yet set such standards for that industry. These determinations are to be made on a case by case basis by States with approved permit programs. Offsets are possible. The EPA must issue guidance for implementing this provision including the establishment of de minimis amounts for the listed pollutants within 18 months of enactment.

The EPA is also required to perform studies of some unique air toxics problems by the amendments. These studies will address the deposition of air toxics in the Great Lakes, Lake Champlain, Chesapeake Bay, and all U.S. coastal waters, the ambient levels of air toxics in urban areas, emission control technology for the coke oven industry, the emissions of air toxics from electric utilities, mercury emissions from industrial sources, hydrogen sulfide sources and control, and hydrofluoric acid sources. The National Academy of Sciences is required by the amendments to perform a comprehensive review of EPA's risk assessment methodologies and procedures and make recommendations on how to improve the process.

DISCUSSION

Mr. William O'Sullivan asked what EPA's schedule was for defining de minimis amounts for the various pollutants for use in implementing the modification provisions. Mr. Harnett stated that Section 112(g) required that EPA publish guidance for fully implementing these provisions including de minimis levels for the listed pollutants, a toxicity ranking for the listed pollutants, and guidance on offsets within 18 months of enactment. Mr. O'Sullivan questioned how the MACT schedule related to the schedule for permit program dates for submittal of permit applications, State review of application, and final decisions on the applications. He was concerned that all sources would need to be given 4 years for compliance with MACT standards. Mr. Harnett indicated that this could be true for the first sources regulated but that over time as the State agencies and industry personnel became familiar with the permit process this might not be necessary.

Dr. John Pinkerton questioned if EPA envisioned the Hazardous Organic NESHAP would meet the requirement to regulate 40 source categories within 2 years of enactment. Mr. Harnett stated that EPA does feel that the HON meets these requirements. Dr. Pinkerton questioned whether EPA could make decisions on all of the related issues such as definition of source and categories and subcategories within 2 years such that the HON could be promulgated on schedule. Mr. Harnett indicated that because most of these issues had been part of the debate on Clean Air Act amendments and people were familiar with the options, it is possible for these decisions to be made timely.

Mr. Paul Arbesman questioned whether the guidance on the modification provisions would be out soon enough for the States. Mr. Harnett indicated that the provisions do not take effect until there is an approved State permit program. He stated that the current schedule shows that it will be at least 2 years before any such programs have been approved so that the guidance will be out prior to the States having to implement these provisions. Mr. Arbesman asked for a clarification of the "12 percent" rule for existing sources. Mr. Weigold indicated that the exact interpretation of this requirement would evolve over time. Mr. Harnett stated that this requirement was developed because Congress recognized that it may not be reasonable to make existing sources meet the level demonstrated by the best controlled source in the category but they also felt there needed to be some "floor" to ensure that the standards for existing really reflected MACT.

Dr. Patrick Atkins questioned if under the quick timetable, EPA was going to skip identifying the "12 percent" level and just look at the most stringent devices. He asked if there is some mechanism to prevent EPA from not doing the identification of

this level. Mr. Harnett indicated there is not a mandate that EPA identify this level each and every time but EPA must assert and demonstrate that the selected MACT level is more stringent than that the "12 percent" level. Dr. Atkins

Mr. Ralph Hise questioned why ammonia and hydrogen sulfide were dropped from the list of pollutants in the Senate bill and whether EPA would be adding them in the future. Mr. Harnett explained that while no specific reasons were mentioned by Congress he felt that they viewed them as being of greater concern for short term high exposures resulting from accidents than from routine emissions. While EPA had no current plans to add these pollutants to the list in Section 112, he indicated that EPA could be petitioned to do so.

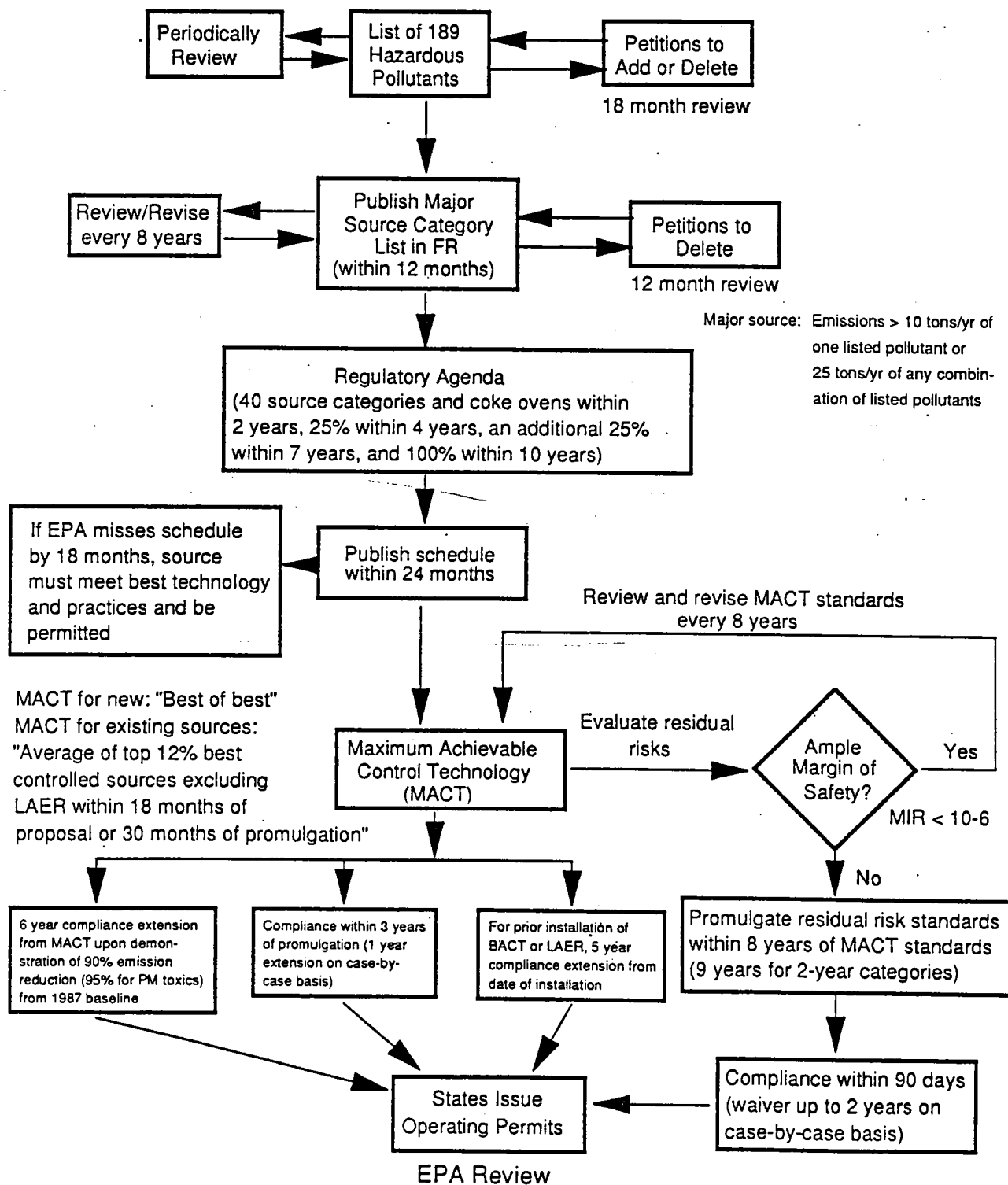
Mr. Donald Arkell asked whether under their air toxics programs whether States could move ahead of EPA in establishing MACT standards for some industries. Mr. Weigold pointed out that nothing precludes States from setting any standards for air toxics.

Mr. Charles Collins questioned whether electric utilities were excluded from control of their air toxics emissions until the required study was completed. Mr. Weigold indicated that is not completely clear but it does not seem to make sense that Congress would want EPA to regulate them before the study is completed. Mr. Harnett pointed out that EPA would not have sufficient data to regulate electric utilities until the study was completed.

Mr. Pinkerton questioned whether we would apply the results of from the electric utility study to industrial boilers. Mr. Harnett indicated that EPA would attempt to consider air toxic emissions from all fossil fuel-fired combustion sources when gather data on electric utilities to the degree it is feasible.

TITLE III

HAZARDOUS AIR POLLUTANTS



**List of 189
Hazardous
Air Pollutants**

- **Petitions to add or delete**
- **Periodic review by EPA**

Publish Major Source Category List

- **Petitions to delete**
- **EPA review/revise every 8 years**

Regulatory Agenda

- **40 source categories & coke ovens within 2 years**
- **25% of the list within 4 years**
- **50% of the list within 7 years**
- **100% of the list within 10 years**
- **Publish schedule within 2 years**

Maximum Achievable Control Technology (MACT)

- **New sources: "Best of the best"**
- **Existing sources: "Average of the best 12%"**

Early MACT Standards

- **Coke ovens**
- **Hazardous organic NESHAP**
- **Dry cleaning**
- **Chromium electroplating**
- **Commercial sterilizers**
- **Asbestos - Comprehensive Revisions**

FUTURE CATEGORIES

- **PETROLEUM REFINERIES**
- **IRON AND STEEL**
- **PULP AND PAPER MILLS**
- **BULK TERMINALS**
- **POLYMERS AND RESINS**
- **WOOD FURNITURE
MANUFACTURING**
- **MAGNETIC TAPE
MANUFACTURING**
- **SURFACE COATING
INDUSTRIES**

MACT Compliance Schedule

- **Normal: 3 years plus 1 year extension**
- **Early Reduction (90%/95%): 3 years + 6 years**
- **BACT/LAER: 5 years from installation**

Residual Risk

- **"Ample margin of safety"**
- **If MIR > 1 in 1 million - must set risk standards**
- **Review within 8 years of MACT (9 years for 2-year categories)**
- **Compliance within 90 days (maximum of 2 years)**

SOLID WASTE INCINERATION

- **Large MWC Standards**
- **Small MWC Standards**
- **Medical Waste Incineration Standards**
- **Commercial/Industrial Solid Waste Incineration Standards**

Modification Provisions

- **Increase in emissions above de minimis amount**
- **Offsets possible but relative toxicity must be less**
- **Case-by-case MACT standards**

KEY AIR TOXICS STUDIES

- **Great Lakes Deposition**
- **Urban Air Toxics**
- **Coke Oven Technology**
- **Electric Utility Emissions**

OTHER AIR TOXICS STUDIES

- **Mercury Emissions**
- **NAS Risk Assessment Study**
- **EPA Risk Assessment Study**
- **Electric Utility Emissions**
- **Hydrogen Sulfide**
- **Hydrofluoric Acid**

ACCIDENTAL RELEASES

- Pollutant List
- Hazard Assessments
- Prevention Regulations
- Chemical Safety Board
 - Accident Investigation
 - Prevention Recommendations

III. Definition of Source

EPA PRESENTATION

Mr. Jim Weigold
Emission Standards Division
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

SUMMARY

The definition of source can affect how several provision of Title III are implemented. There are various alternative interpretations possible and an example plant will be used to illustrate these interpretations and their potential impacts. The provisions where the definition of source could have a significant impact on the following provisions: 1) the definition of major source; 2) applicability of MACT standards; 3) MACT standards; 4) early reduction program; and 5) residual risk reviews. The example plant is composed of a variety of different production processes on one site under common ownership including ethanolamines production, styrene butadiene rubber production, ethylene dichloride production, butadiene production, ethylene oxide production, and individual sources such as a boiler and cooling tower.

The definition of major source and what it includes is an essential determinant of what is subject to regulation. It is the trigger for the list of source categories and the unit for application of the modification provisions. It also defines what is an area source because area sources are defined as any source which is not a major source. The language of Section 112(a) it implies it is everything within a contiguous area. This would mean that you total all of the emissions of listed air toxics from the entire industrial plant to see if they exceed the cutoffs. Another way would be to include only those points that would be covered by an individual MACT standard. No decision has been made by EPA.

The second key issue is what is a source for making decisions on the applicability of MACT standards. One way would be that the you look at all of the emissions of listed air toxics from the plant to determine if the cutoffs are exceeded and therefore, the plant is subject to MACT standards. This would mean that a MACT standard for butadiene production would apply to our example plant if the emissions from the total site exceeds the cutoff regardless of the emissions from the butadiene process

unit exceed the cutoff. An alternative choice would be to look at the sources covered by MACT standards and cover those sources only if their emissions exceed the cutoff. For example if the butadiene unit was below the cutoffs it would not be covered by MACT standards for butadiene. This is a key issue because EPA will not always regulate all sources on the plant site at the same time.

The third issue is whether MACT standards must be developed for all sources on the same site at the same time or may EPA set standards for parts of the facility at different times. When you consider plants such as the Shell plant in Deer Park, Tx, which stretches on for over a mile and includes a petroleum refinery and chemical production units, it is infeasible to address all sources on a plant site at the same time. Therefore, it will be necessary to address parts of some plants with different MACT standards at different times.

The fourth issue relates to the program in Title III to encourage plants to reduce their air toxic emissions early rather than waiting for MACT standards. This provision gives plants a 6-year extension from compliance of MACT for plants which achieve early reductions of at least 90 percent in air toxics emissions. The goal of this provision is to achieve reductions in air toxics as quickly as possible. The issue is what source or group of sources must a plant get its reductions from to receive an extension. The options for the definition of source for this provision are: 1) the same sources covered by a specific MACT standard; 2) all of the sources destined for coverage by MACT standards; 3) individual sources or groupings of sources within the process covered by a specific MACT standard or 4) the entire contiguous plant. The industry would like to be able to group sources anyway they would like and achieve the 90 percent reduction over those sources.

The fifth issue relates to the definition of source as it relates to the residual risk reviews that are required. The first step is to ask what is the purpose of the residual risk test. There seem to be two potential purposes: 1) a test of the effectiveness of the MACT standards which they are directly linked to and 2) a test of the risk from the entire plant site after application of MACT standards. The options for the definition of source are: 1) the same as that for a specific MACT standard; 2) all sources covered by promulgated MACT standards; or 3) the entire plant site. Because of the risk studies required to be performed by the National Academy of Sciences and EPA, EPA is going to defer deciding on this issue until those studies are to be done. However, it is a very significant decision.

DISCUSSION

Ms. Vivian McIntire questioned whether EPA had decided on whether it would be issuing regulations or guidelines to implement the early reduction provision. Mr. Weigold indicated that no decision had been made on that issue.

Mr. William Dennison indicated that these were certainly critical decisions to make and it was quite possible that what makes sense in general may not make sense for in a specific situation. In particular, he felt that in looking at residual risk there could be some conflict between what makes the most sense in general and its impact on individual situations. he recommended EPA leave some flexibility to deal with exceptions to the general rule. Mr. Weigold indicated that EPA is hoping that the NAS study will come up with some suggestions on how to approach the residual risk reviews. Mr. Dennison further indicated that it would have been nice if the law had been more explicit. Mr. Weigold indicated that EPA had recommended that the Congress give some explicit guidance but none was included in the final bill or the Committee report.

Ms. Deborah Sheiman stated that there had been an explicit discussion of these issues included in the Congressional Record. Mr. Weigold stated that Senator Durenberger, who had been the key Senator on the drafting of Title III, had included in the record a detailed discussion of the definition of source as it applied to the various provisions. However, he indicated that other members of Congress had made clear that they felt that any such language represented only one Senator's opinion and not the consensus of the Conference Committee.

Mr. O'Sullivan suggested that for the first permit renewal (approximately 10 years) the residual risk after application of the MACT standards for a plant be reviewed for all of the sources at the plant. Mr. Weigold stated that because of the large workload required doing MACT standards and the mandated residual risk evaluations and regulations, EPA would not like to begin other activities that are not required. In addition, he pointed out that States are not precluded from doing risk assessments of all of the sources at individual plants if they wish.

Mr. Arbesman questioned whether a small plant could avoid MACT standards by reducing their emissions below the 10 and 25 tons per year cutoffs. Mr. Weigold indicated that a source is not automatically exempt from MACT standards by being below these cutoffs because EPA has the authority to regulate small sources.

Mr. Ardesman questioned if Mr. Weigold was referring to EPA authority to lower the cutoffs for individual pollutants. Mr. Weigold stated that the authority he was referring to was the authority to regulate any category of small source that warranted it regardless of pollutants emitted or emission levels.

Mr. Atkins pointed out that if a more flexible definition of source was used in the early reductions program there would be greater participation by industry. He questioned whether EPA was looking to get significant reductions out of the early reductions program or was going to rely predominantly on the MACT standards. Mr. Weigold indicated that EPA believes the early reductions program can be a very effective program in reducing emissions if properly structured. He also pointed out that EPA was aware that the more complex the program the less likely it is that industry will participate. However, he also pointed out that to be successful the program and the emission reductions it achieves must be credible.

DEFINITION OF SOURCE UNDER TITLE III

- **"SOURCE" AFFECTS HOW SEVERAL
TITLE III PROVISIONS WILL BE
IMPLEMENTED**
- **WE WILL LOOK AT SOME ALTERNATIVE
INTERPRETATIONS OF "SOURCE" FOR
TITLE III**
- **WE WILL USE A HYPOTHETICAL CHEMICAL
COMPLEX TO ILLUSTRATE IMPLICATIONS**

TITLE III PROVISIONS

"INVOLVING "SOURCE"

- **WHAT IS A "MAJOR SOURCE"?**
- **HOW DO REGULATIONS APPLY AT A MAJOR SOURCE?**
- **WHAT IS A "SOURCE" FOR THE PURPOSES OF MACT?**
- **WHAT IS A "SOURCE" FOR THE PURPOSES OF THE EARLY REDUCTION COMPLIANCE EXTENSION?**
- **WHAT IS "SOURCE" FOR THE PURPOSES OF RESIDUAL RISK?**

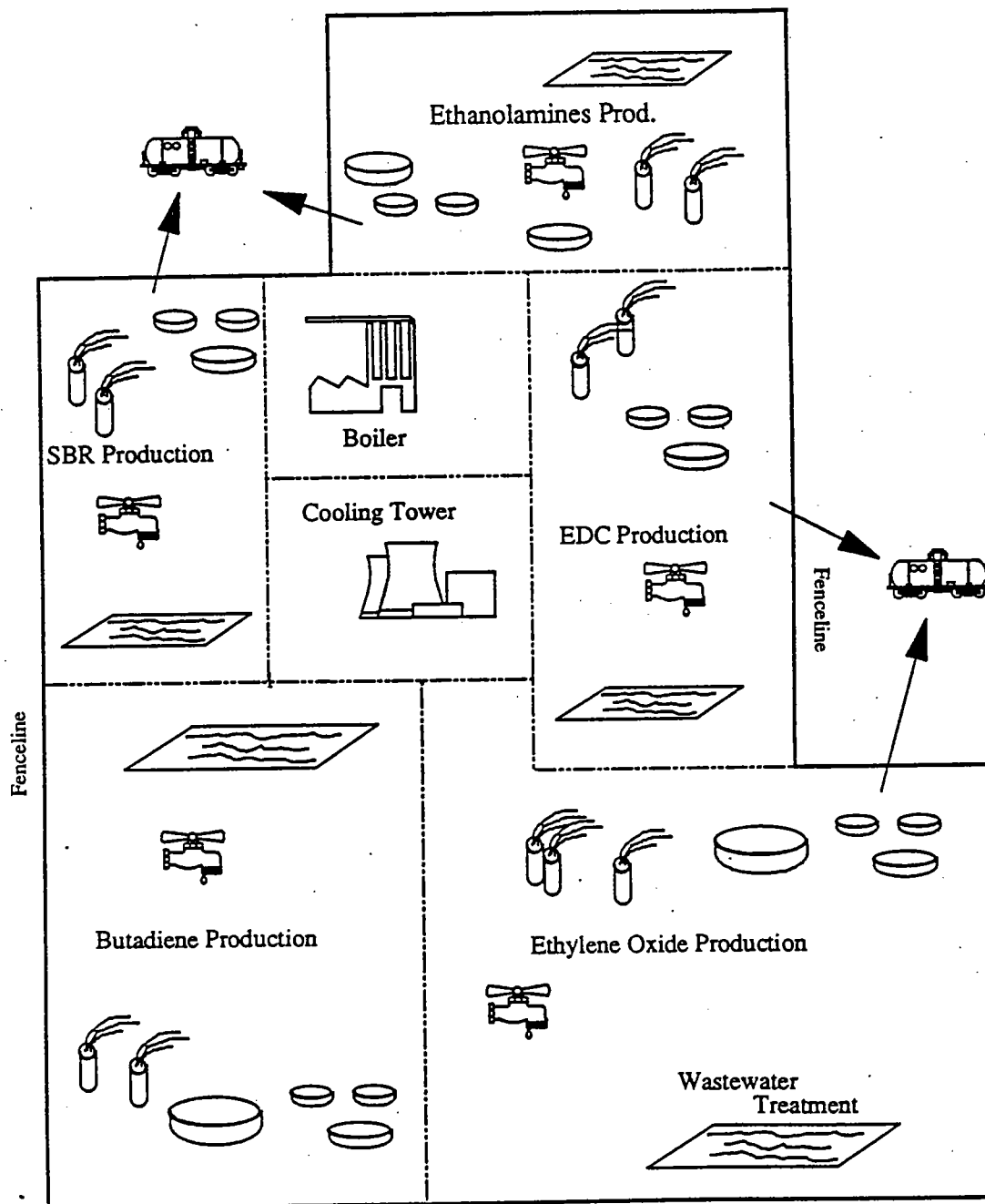
PLANT CONTAINING SEVERAL SOURCE CATEGORIES



vents



equipment leaks



MAJOR SOURCE

- **BASIC DETERMINANT OF WHAT IS SUBJECT TO REGULATION**
- **DEFINES WHICH SOURCES ARE "AREA" SOURCES**
- **IS THE FOCUS OF ANY LESSER QUANTITY CUTOFF THAT MAY BE ESTABLISHED**
- **ALTERNATIVES:**
 - A. EVERYTHING "LOCATED WITHIN A CONTIGUOUS AREA AND UNDER COMMON CONTROL"**
 - B. ALL THE EMISSION POINTS CONTAINED IN THE ENTITY COVERED BY A MACT STANDARD**

APPLICABILITY AT A MAJOR SOURCE

- **EACH MACT STANDARD MAY NOT COVER
AN ENTIRE CONTIGUOUS FACILITY**
- **IF MACT APPLIES TO PART OF A
CONTIGUOUS FACILITY, HOW BIG DOES
THAT PART HAVE TO BE?**
- **ALTERNATIVES**
 - A. MACT APPLIES TO THE PART
REGARDLESS OF EMISSIONS LEVEL**
 - B. PART COVERED MUST ITSELF BE
10/25 TPY**

MACT

- **IT MAY BE INADVISABLE TO DEVELOP ONE MACT PROMULGATION FOR AN ENTIRE CONTIGUOUS FACILITY**
- **CONGRESS GIVES EPA DISCRETION TO WRITE STANDARDS FOR PARTS OF AN ENTIRE FACILITY**
- **ALTERNATIVES:**
 - A. FOCUS ON A PORTION OF THE CONTIGUOUS FACILITY, WHICH MAY RANGE FROM A PROCESS UNIT TO THE ENTIRE FACILITY**
 - B. WRITE EACH MACT STANDARD FOR THE ENTIRE CONTIGUOUS FACILITY**

"VOLUNTARY" REDUCTION EXTENSION

- **PROVIDES FOR 6 YEAR COMPLIANCE
EXTENSION FOR ACHIEVING 90/95 PERCENT
REDUCTION FROM 1987 BASELINE**
- **ESSENTIALLY TRADES TIME FOR EARLY
REDUCTIONS THAT MAY ACHIEVE LESS
THAN MACT**
- **ALTERNATIVES:**
 - A. USE SAME DEFINITION AS MACT**
 - B. ALLOW REDUCTIONS ACROSS ALL
SUBCATEGORIES DESTINED FOR
MACT**
 - C. ALLOW REDUCTIONS ON PARTS OF
"MACT" SOURCE**
 - D. REQUIRE REDUCTION AT THE
ENTIRE CONTIGUOUS FACILITY**

RESIDUAL RISK

- **TWO RELATED ISSUES:**

- 1. WHAT IS THE PURPOSE OF RESIDUAL RISK TEST?**

- 2. HOW MUCH OF A CONTIGUOUS FACILITY IS SUBJECT TO THE TEST?**

- **ALTERNATIVES:**

- A. DEFINE SOURCE THE SAME AS THAT FOR EACH MACT STANDARD**

- B. DEFINE SOURCE TO BE ALL SUBCATEGORIES COVERED BY PROMULGATED MACT STANDARDS**

- C. DEFINE SOURCE AS THE ENTIRE CONTIGUOUS FACILITY**

DISCUSSION WITH THE PUBLIC ON THE FIRST THREE PRESENTATIONS

After the presentation and discussion by the NAPCTAC members on the Petition Process, the floor was opened to allow questions from any of the public on the subjects of the first three presentations. Ms. Karen Olson of the Texas Air Control Board (TACB) questioned whether it was going to be the responsibility of OSWER to implement the accidental release provisions of Title III. She also asked whether the 100 pollutants to be listed by EPA under the accidental release provisions would all be air pollutants. Mr. Harnett explained that under the Superfund program, OSWER had been performing a study into accidental releases of toxic pollutants into all media and on methods for preventing such accidents. Because their experience, OSWER was chosen to implement the accidental release provisions. However, the list of pollutants to be developed would all be air pollutants. Ms. Olson questioned as to when the list would be established and whether EPA would continue to publish the guidance documents related to accidental releases. Mr. Harnett stated that the list was required to be developed by November 1992. Related to the guidance documents, Mr. Harnett indicated that guidance documents would continue to be issued and would be the basis for the regulations required under the accidental releases provisions.

Mr. Joe Hovis of Union Carbide asked how soon EPA would be willing to sit down and hold pollutant petition conferences. Ms. Pate indicated that they would be willing to meet as early as the following week.

Mr. Bob Ajax of Omni questioned how EPA was going to use the definition of major source in setting MACT standards. In particular, he questioned whether small polymer and resin production units which were stand alone units and emitted less than the cutoffs would be covered. Mr. Weigold pointed out that EPA had authority to regulate all sizes of a source and no decisions on the coverage of any particular industry had been made as yet.

Ms. Kathryn Gunkel of the National Asphalt pavement Association questioned whether EPA would automatically add pollutants which OSHA lists as carcinogens. Mr. Kellam stated that there was no direct linkage between the two laws but consideration would be given by EPA based on such an action.

Ms. Louise Noel of BASF questioned where a source emitted three different pollutants and only one was on the list of hazardous air pollutants would the MACT standards affect the other pollutants. Ms. Pate indicated that, while the standards would not directly address the other two pollutants, the control device installed to meet the standards may reduce those pollutants as well as the regulated one. Ms. Noel also questioned how EPA would react to early reduction requests which

reflected that a plant was substituting non-listed chemicals for listed hazardous chemicals in their production process. Mr. Weigold indicated that such applications would be closely reviewed but no specific guidelines have been established.

Ms. Francis Sharples of Oakridge National Laboratories questioned whether, in cases where a plant emitted large amounts of 1 or 2 listed chemicals and small amounts of other listed chemicals, all of the sources would need to be controlled even the small ones. Mr. Weigold responded that it was the intent of the amendments that EPA look at the emissions of all of the listed pollutants from the plant site in developing regulations not just those emitted in the largest quantities.

Ms. Jodi Bakst of Weinberg, Begeson, and Neuman questioned whether EPA would be looking at innovative ways to reduce pollution. Mr. Weigold stated that EPA hopes to stimulate many efforts on the part of industry toward pollution prevention and source reductions of pollution. He also indicated that the MACT standards would be structured to allow for innovative emission reduction techniques wherever possible.

Mr. Don Crane of W.R. Grace questioned whether once EPA establishes the emissions cutoff for individual pollutants related to the definition of "major source," could States further reduce these cutoffs. Mr. Weigold stated that the States always have the option to be more stringent than EPA and, therefore, could lower these limits.

Mr. Michael Pucci of ATT of questioned under what authority would EPA have the right to question the substituting of a non-listed chemical for a listed chemical by an industrial. Mr. Weigold stated that such a plant would require an operating permit and as part of that process it is reasonable to assume that the State and EPA will scrutinize such changes.

Ms. Shari Beth Libicki of Environ Corporation questioned how EPA would make decisions on lowering the emission cutoff for individual pollutants related to the definition of major source. Mr. Weigold indicated that the EPA was currently grappling with this issue and no decisions had been made.

Mr. Greg Gasperez of Lanier and Associates questioned whether, for toxic particulates such as chromium, we would be regulating total emitted particulate matter or inhalable particulate matter (PM-10) and would the 95 percent early reduction program be on the basis of total emitted particulate matter or only PM-10. Mr. Weigold indicated that it would be on the basis of the regulated pollutant which would generally be PM-10.

Mr. George Walsh of Entropy questioned whether there was a Federal/State work group on the development of emission testing methods and would these people be included in the review process

for compliance demonstrations. Mr. Weigold stated, while he was unaware of a Federal/State work group, there is a lot of work being done by the OAQPS Emission Measurement Branch and EPA's Office of Research and Development on the development of test methods for the 189 listed pollutants. He also indicated that these persons would be involved in evaluating test methods and data submitted to demonstrate compliance or in support of early reduction applications.

Ms. Liz Fisher of Rohm and Haas stated that there were at least two types of "early reductions" which appeared possible under Section 112: 1) reduce your emissions of listed pollutants below the 10 and 25 tons per year cutoff and 2) to substitute a non-listed chemical for a listed chemical in your production process. She expressed concern that based on today's discussion that these were not viable options. Mr. Weigold indicated that the second approach was clearly acceptable. However, he indicated that the first approach might not allow a plant to avoid standards under Section 112 because EPA may lower the cutoff for an individual pollutant or may regulate small or area sources within an industry. Ms. Fisher stated that this uncertainty would discourage industry trying to get early reductions. Mr. Weigold indicated that this should not be the case generally.

Mr. Ernest Rosenberg of Occidental Petroleum Company questioned whether reductions in toxic VOC's and particulate matter as part of the early reduction program would count as offsets under the new source review program for VOC's and particulate matter. Mr. Weigold indicated that no decision on this issue had been made by EPA. Mr. Pucci of ATT supported the idea of getting credit for VOC and particulate matter reductions as a result of "early reductions" in air toxics. Mr. Weigold reiterated that this was an issue EPA would address.

Mr. Chuck Grigsby of BASF Corporation questioned whether, if after EPA sets a MACT standard for an industry and a State subsequently sets a more stringent standard and it is achieved by a source, EPA must come back and review the original MACT standard. Mr. Weigold indicated that the law requires EPA to review the standards every 8 years and because of EPA's huge workload, it is unlikely we will review the standards any earlier.

Mr. Paul Tranquill of BP Oil questioned what EPA had decided related to the base year for calculating early reductions in air toxics and whether any reductions of air toxics could count even if they were required by a different EPA or State program. Mr. Weigold stated that for the base year a company could use 1987 or a later year or if they had submitted data on their emissions as a result of an inquiry under Section 114 of the Clean Air Act in 1985 or 1986, they could use that year. He also stated that any reductions in air toxics from the base year may count toward the early reduction levels. Mr. Tranquill questioned by when must

the reductions be achieved. Mr. Weigold stated that generally they must be achieved prior to proposal of the MACT standards. . He noted that for the earliest regulated categories such as those covered by the Hazardous Organic NESHAP a plant need only make an "enforceable commitment" to reduce the air toxics prior to proposal.

Ms. Olson of TACB questioned whether even reductions which were required as a result of State law or regulation would count towards the early reduction program. Mr. Weigold stated that all reductions could be included in the applications regardless of what may have caused them to happen.

Mr. MaKinen of American Sterilizer questioned if there was a source reduction method for a industry which reduced air toxics by 90 percent and there was a control technology which reduced emissions by 95 percent, would EPA ignore the source reduction method in setting MACT standards. Mr. Weigold indicated that EPA was aware of this issue and would most likely deal with case-by-case for each source category.

IV. PETITION PROCESS

EPA PRESENTATION

Dr. Nancy B. Pate
Emission Standards Division
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

SUMMARY

Title III of the Clean Air Act Amendments (CAA) of 1990 contains an initial list of 189 hazardous air pollutants. There are three lists, or requirements for lists, in the Act. In addition to the pollutant list, there will be a source category list and an accidental release list. For each list, there will be a petition procedure for modification.

The source category list petition process only addresses delisting petitions. The Act, per se, is silent on additions. The accidental release list, and the associated petition process will be administered by the Office of Solid Waste and Emergency Response. The Air Program Office will be coordinating closely with them.

The new Act clearly places the burden of proof that any pollutant is or is not toxic, on the petitioner. Under the previous Clean Air Act, the EPA had the burden of gathering all the appropriate information in order to list or delist a compound. Consequently, EPA has a good idea of what would be required to list or delist any pollutant. A pre-petition conference is very strongly recommended for anyone considering petitioning the Agency to list or delist any pollutant.

The presentation today will be an overview of the statutory criteria and data requirements outlined in the Act and, to some extent, our preliminary interpretation of those data requirements. This presentation will concern only the pollutant list petition process, not source categories or accidental releases.

What does it really mean to be on the Hazardous Air Pollutant List? It does not necessarily mean that every source emitting any listed pollutant will be regulated. However, this may have been the intent. It does identify the universe of source categories that may be regulated. The CAA Amendments require the Source Category List to be published by November 15th of this year. Emission regulations are expected to be source-by-source, not pollutant-by-pollutant. To some extent, the magnitude of the emissions and the toxicity profile of the listed pollutants will influence prioritization of the source categories for regulatory evaluation.

How the term source, or source category, will be defined is still the subject of much debate. In the end, there may be multiple definitions. Assuming a "source" to be a source category where each facility has identical emissions subject to common control, we will attempt to graphically present "What would it mean if any given listed pollutant were to be "delisted". Say we have two source categories represented. Both Sources emit five pollutants each. Source A emits two pollutants that are not on the list, and three listed pollutants. Source B emits four pollutants not on the list, and one listed pollutant. At source A, if one listed pollutant were to be "delisted", the source could still be subject to emission regulations under the new Act. At source B, if the single listed pollutant were to be "delisted". The source category would not be subject to source category emission regulations under the Act.

The Act precludes accepting pollutant list petitions until 6 months post-enactment. This would be May 15th of this year. The Agency is attempting to publish a list of what will be required in an adequate, or complete, petition by early spring 1991. However, the Act does not require this. Congress established a statutory review time of 18 months for any adequate pollutant list petition received. The 18 month time clock will not start until the petition is deemed complete. The initial review, to assess adequacy, is expected to take 3 weeks or less.

Some of you may be familiar with the Superfund Amendments and Reauthorization Act of 1986 (SARA), Section 313 petition process and will notice some similarity here. They only have 6 months to review a petition and we have 18 months. Also, their statutory authority is not as long, nor as strong, as the new CAA. One clear difference is that, for SARA, the burden of proof falls on EPA, not on the petitioner, as is the case in the new CAA.

As indicated previously, a Pre-petition conference is strongly recommended to assist the petitioner in developing an adequate petition to modify the list. Once the petition is received and the data content in the petition is determined to be adequate, the Agency will publish a public notice of receipt. The key here is "adequate", if a petition does not contain all the necessary data, the EPA will return the petition to the submitter with a letter explaining the inadequacies.

The notice of receipt will notify the public that a petition has been received and will list the data submitted. It will request public comment on the petition and call for any additional data to be submitted. The data in the petition will be reviewed by an EPA work group consisting of experts in all the subject areas to be considered. All appropriate offices will be involved, including the Office of Research and Development, the Office of Policy Analysis and Review, the Office of Policy

Planning and Evaluation, the Office of Pesticides and Toxic Substances and EPA Regional Offices. The Agency will then publish a final decision to grant or deny the petition within the 18 month time frame allowed.

The three general areas of consideration, spelled out in the Act, are health effects, environmental effects and exposure. The Act gives a substantial amount of detail in all of these areas of consideration. By statute the endpoints to be considered are cancer, mutagenicity, teratogenicity, neurotoxicity, reproductive dysfunction, acute toxicity, chronic toxicity and the language also allows consideration of any other endpoint that the data reveal. Under the previous CAA, cancer was the primary endpoint of concern. Now all health endpoints can be considered.

By statute, the potential for adverse environmental effects must be considered. Effects on wildlife, aquatic life, natural resources, endangered or threatened species, and other adverse environmental impacts will be considered. This is something new in the Hazardous Air Pollutant Program since environmental considerations were not allowed in the CAA before it was amended.

The last criteria to be considered is exposure. By statute, petitions are required to consider ambient concentrations, bioaccumulation, deposition or other routes of public or environmental exposure. The exception is that accidental releases are specifically excluded since they are addressed elsewhere in the Act.

The submitted data will be evaluated and any decision made in accordance with statutory requirements. Subsection (B) is for additions and Subsection (C) is for deletions. The statements are similar except that (B) requires the pollutant to be an air pollutant. For simplicity, only Subsection (C) is shown here.

"(C) The Administrator shall delete a substance from the list upon a showing by the petitioner or on the Administrator's own determination that there is adequate data on the health and environmental effects of the substance to determine that emissions, ambient concentrations, bioaccumulation or deposition of the substance may not reasonably be anticipated to cause any adverse effects to the human health or adverse environmental effects."

As mentioned previously, EPA is in the process of developing a petition adequacy rule to assist any potential petitioners in submitting an adequate petition. The word "adequacy" here means petition data content, not quality of the data or studies submitted. As a starting point, petitions will be required to provide a level of evaluation comparable to that

of the Agency when evaluating pollutants for listing as hazardous air pollutants, or the retention of pollutants on lists, such as the SARA 313 reporting list.

An adequate petition will require:

1. comprehensive literature searches to assist in identifying health and environmental effects and to help characterize environmental fate;
2. documentation of nationwide emissions and estimation methods used for all source categories emitting that pollutant; several emission estimation methods will be acceptable;
3. representative exposure modeling and/or monitoring data.

The petitioners must use EPA approved models and monitoring methods. They must include an evaluation of the highest emission sources in each source category emitting the pollutant as well as those sources exposing the greatest number of people.

An obvious issue is whether or not petitioners will have to provide data for all health and environmental endpoints or only the primary endpoints associated with the pollutant. Experience tells us that a balanced case-by-case approach is probably in order here. If the literature screen does not reveal any additional endpoints, the supporting data will naturally center around the primary effect of concern.

It is highly unlikely that the Agency would consider taking any pollutant, with a large body of data available on any potential health or environmental effect, off the list, except if emissions were extremely low. In the latter case, the source category would probably not warrant emission regulations anyhow.

What would happen if the data are determined to be "not sufficient"? The statutory language directs the Administrator to use any authority available to acquire additional information. This will include further testing of the compound if necessary.

A major issue is what will happen to the 18 month review time when the data are found to be "not sufficient" to support a listing or de-listing decision. Another major issue is "What constitutes sufficient data?" Our initial thoughts are that the petition would be denied, or any decision to add would be deferred, until the data were available. However, when the data are available, the petitioner will not need to submit a full petition, they would only need to submit the updated information. In addition, the full 18 month time clock would not be started again, in this case, a reasonable time interval will be negotiated with the petitioner.

As to what will constitute sufficient data, we plan to evaluate the data on a case by case basis. The Office of Research and Development and the Air Office plan to develop data evaluation guidance with the assistance of many other offices within EPA. This guidance will be published for public review and comment. The EPA is under intense time constraints, but plans to propose a petition adequacy rule in spring of 1991, before the earliest petition submittal date of May 15th.

This will be a relatively simple check list of what needs to be included in a complete petition. A draft of this check list will be available for discussion during pre-petition conferences. While some variation is expected, the petition criteria will be largely similar to the data requirements for the source category and accidental release petition processes as they are developed. The general evaluation criteria will be for public review and comment. The evaluation criteria guidance document is expected to be a "living document" and will be revised from time to time as insight is gained.

DISCUSSION

Mr. William Dennison of the Committee requested clarification of the highest emission sources and those sources posing the highest risk. Dr. Pate reiterated that petitioners must include an evaluation of the highest emission sources in each source category emitting the pollutant as well as those sources exposing the greatest number of people. This would address the "highest risk" issue.

Ms. Vivian McIntire of the Committee, requested clarification on whether a petitioner would be required to submit actual data for every health and environmental criteria.

Dr. Pate responded that if the comprehensive literature search did not reveal any concern associated with any given health or environmental endpoint, the petitioner would not need to develop the data before a petition would be considered. However, should the comprehensive literature search indicate some concern, the Act did allow the Administrator to obtain data necessary to support a decision to modify the list.

A member of the audience asked what would happen if an industry started to use a substitute for the listed pollutant? Mr. Weigold commented that the policy directive is emission control and pollution prevention. Dr. Pate added that the EPA could not exclude the possibility that the substitutes could be added to the list of hazardous air pollutants.

A member of the audience asked how the EPA would view recycling or reuse as opposed to controls that would just change media for ultimate disposal. Dr. Pate said that the EPA encouraged such solutions as being in keeping with the pollution prevention and fully acceptable for emission reduction.

Ms. Deborah Sheiman of the Committee, expressed concern about the effort level to add pollutants to the list being too difficult. Dr. Pate stated that the EPA would work with petitioners to both add and delete pollutants on a case-by-case basis. Dr. Pate also reminded the Committee that the EPA also has the authority to add or delete pollutants from the list on its own initiative.

Ms. Vivian McIntire of the Committee expressed concern that the effort to delete a pollutant from the list would be more difficult than the effort to add a pollutant to the list. Dr. Pate agreed with the scientific truism that it is more difficult to prove the negative than to support the positive, but indicated that they would be as balanced as possible in developing the adequacy criteria.

**POLLUTANT LIST
PETITION PROCESS**

NAPCTAC MEETING

JANUARY 1991

OVERVIEW

THREE PETITION AREAS in the CAAA

- Pollutant List
- Source Category List (delisting only)
- Accidental Release List

BURDEN of PROOF on PETITIONER

- Pre-Petition Conference Recommended

REVIEW CRITERIA and DATA REQUIREMENTS

WHAT DOES IT MEAN TO BE ON THE HAP LIST?

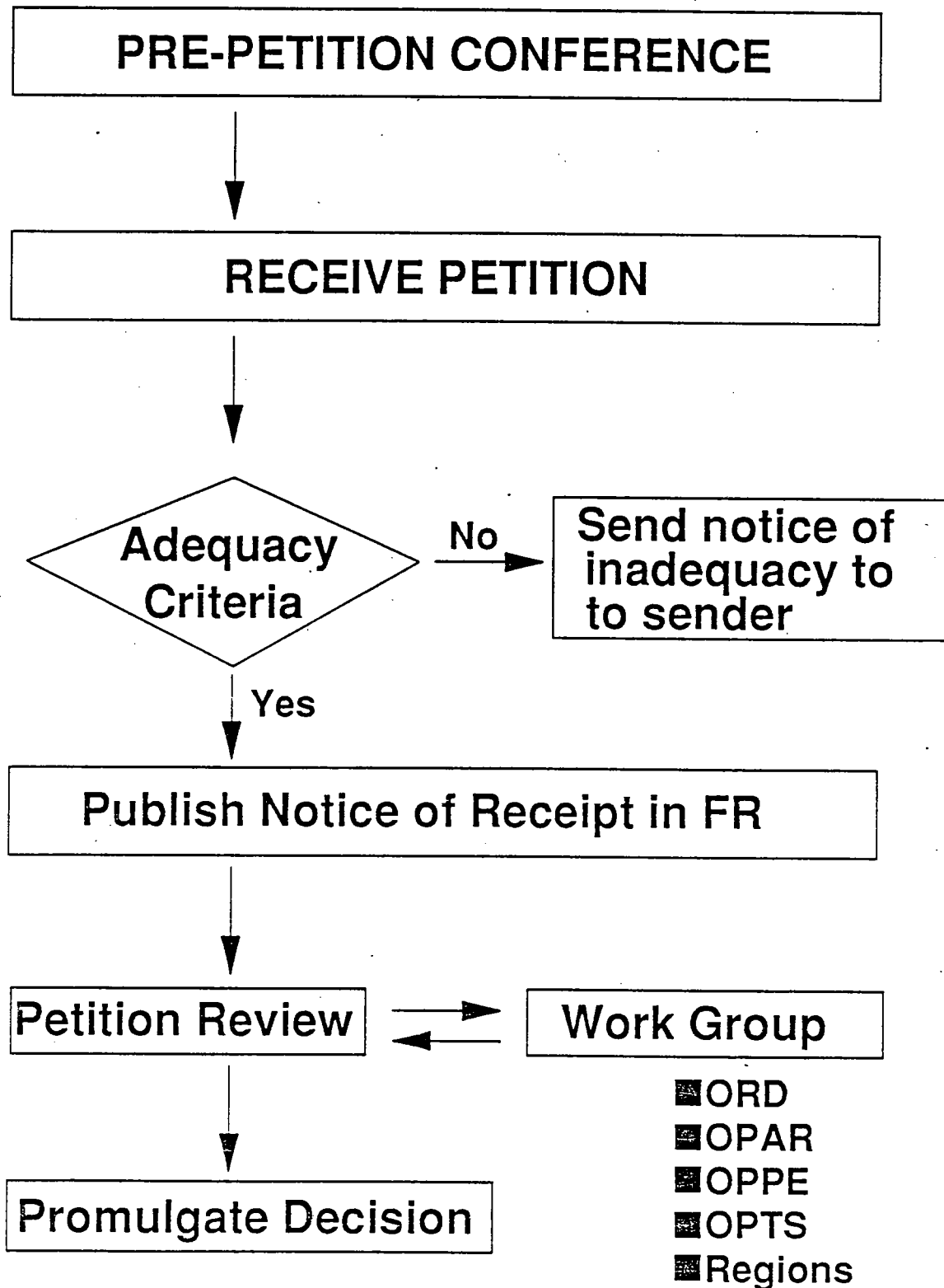
- Does not necessarily mean regulation
- Does identify the universe of sources that may be regulated
- CAA requires source category list to be published by November 15, 1991
- Magnitude of the emissions and toxicity of the listed compounds will influence prioritization of source categories for regulatory evaluation

Source A		Source B	
Not Listed	xxxxx xxxxx	Not Listed	xxxxx xxxxxxx xxxxxxx
Listed	<hr/> xxxxx xxxxx xxxxx	Listed	<hr/> xxxxx

POLLUTANT PETITION PROCESS

- **Petitions precluded until 6 months post-enactment**
- **Adequacy Rule - Spring 1991**
- **Time Permit on Petition Decisions - 18 Months**
- **Similar to SARA 313 Process**

POLLUTANT PETITION PROCESS



REVIEW CRITERIA

1. Health Effects

2. Environmental Effects

3. Exposure

HEALTH EFFECTS

- Cancer
- Mutagenicity
- Teratogenicity
- Neurotoxicity
- Reproductive Dysfunction
- Acute Toxicity
- Chronic Toxicity
- Other

ENVIRONMENTAL EFFECTS

- **Wildlife**
- **Aquatic Life**
- **Natural Resources**
- **Endangered or Threatened Species**
- **Other Adverse Environmental Quality or Impacts**

EXPOSURE

- **Ambient Concentrations**
- **Bioaccumulation**
- **Deposition**
- **Other (except accidental releases)**

DELISTING AUTHORITY

[Section 112(b)(3)(C)]

“(C) The Administrator shall delete a substance from the list upon a showing by the petitioner or on the Administrator’s own determination that there is adequate data on the health and environmental effects of the substance to determine that emissions, ambient concentrations, bioaccumulation or deposition of the substance may not reasonably be anticipated to cause any adverse effects to human health or adverse environmental effects.”

PRELIMINARY GUIDANCE

An adequate petition will require:

- **Comprehensive Literature Searches**
 - Health Effects
 - Environmental Effects
 - Environmental Fate
- **Documentation of Nationwide Emissions and Estimation Methods Used**
 - All Source Categories
- **Representative Exposure Modeling and/or Monitoring**
 - Use EPA Approved Models and/or Monitoring Methods
 - Evaluation of Highest Emitting Source in each Source Category

Issue:

- **Will petitioner have to provide data for all health and environmental endpoints?**

DATA INSUFFICIENCY

Section 112(b)(3)(D)(4)

"If the Administrator determines that information on the health or environmental effects of a substance is not sufficient to make a determination required by this subsection, the Administrator may use any authority available to the Administrator to acquire such information."

Issues:

- Impact on 18 month review time line
- What constitutes sufficient information or quality data?

Interim Approach:

- Evaluate case by case
- Review Guidance under development

NEXT STEPS

■ **Publish Petition Content Requirements Spring 1991**

■ **Publish Data Evaluation Guidance**



CHEMICAL MANUFACTURERS ASSOCIATION

Geraldine V. Cox, Ph.D.
Vice President-Technical Director

January 31, 1991

Mr. James B. Weigold
Acting Director
Emission Standards Division (MD-13)
U. S. Environmental Protection Agency
Research Triangle Park, NC 27711

RE: Comments on Pollutant List Petition Process Presented at
January 29-31, 1991 NAPCTAC Meeting

Dear Mr. Weigold:

The Chemical Manufacturers Association (CMA) submits the enclosed comments on EPA's Pollutant List Petition Process scheduled for presentation at the January 29-31, 1991, meeting of the National Air Pollution Control Techniques Advisory Committee (NAPCTAC). These written comments are being submitted in lieu of an oral statement. We request that these comments be added to the record of the meeting.

In addition, CMA would like to work with members of your staff as you proceed with development of the Pollutant List Petition Process. Karen Fidler, of my staff, will contact you within the next few weeks to discuss ways in which CMA can contribute.

Please contact Ms. Fidler at (202) 887-1176 if you have any questions about the enclosed comments.

Sincerely,

CHEMICAL MANUFACTURERS ASSOCIATION

COMMENTS ON EPA'S

POLLUTANT LIST PETITION PROCESS

The Chemical Manufacturers Association (CMA) appreciates the opportunity to comment on the materials developed by the Environmental Protection Agency (EPA) for the January 29-31, 1991, meeting of the National Air Pollution Control Techniques Advisory Committee (NAPCTAC). CMA is a nonprofit trade association whose member companies represent over 90 percent of the production capacity of basic industrial chemicals in the United States. Our members produce and use many of the chemicals included on the list of hazardous air pollutants in Section 112(b) of the Clean Air Act Amendments of 1990. In addition, CMA members produce many other chemicals not currently on the list. Therefore, CMA has a significant interest in the petition process that EPA is developing to add or delete chemicals from the hazardous air pollutant list.

CMA supported the 1990 amendments to Section 112 of the Clean Air Act that provided for a list of specific hazardous air pollutants to be regulated by EPA. CMA further supported the provision for a petition process to add or delete chemicals from the list based on a showing of sufficient evidence on the health or environmental effects of the substance, or lack thereof.

Based on the materials distributed by EPA prior to the NAPCTAC meeting, it is difficult to evaluate and comment definitively on the Agency's planned approach at this time. However, CMA believes that the development of an objective, scientifically based procedure for the addition and deletion of chemicals to the list of hazardous air pollutants is essential if this process is to operate as Congress intended. Therefore, CMA offers the following recommendations to EPA as they proceed with developing the Pollutant List Petition Process.

First, CMA supports proactive development of an objective, scientifically based petition process in anticipation of petitions to the Agency. The petition process should outline the criteria and supporting evidence that will be required to add or delete a substance from the list. These criteria should have a sound scientific basis and should consider the potential for the chemical to cause or reasonably be anticipated to cause significant adverse human health effects at ambient air concentration levels. Establishing the criteria up front will help to ensure that individual petitions are evaluated on a consistent basis and that Agency decisions to add or delete chemicals from the list are accordingly consistent. In addition, a well-defined process will enable petitioners to focus efforts on providing the evidence needed by EPA to support listing/delisting decisions. This will help to conserve resources that may otherwise be spent by petitioners and the Agency alike in processing petitions with inadequate supporting information.

Second, CMA recommends that the petition process provide for timely Agency review and approval of petitions that meet the criteria established by EPA. Given the stringent deadlines in the Clean Air Act Amendments for EPA to promulgate MACT standards and for facilities to implement controls, failure to act on listing/delisting pollutant petitions in a timely manner could significantly impact a facility's ability to adequately plan for compliance. For example, if a petition for deleting the pollutant is pending, the facility will have to implement controls even though EPA may later rule that the pollutant is to be deleted from the hazardous air pollutant list. Similarly, if a facility is subject to MACT standards for a source that emits a pollutant for which a petition to add the pollutant to the hazardous air pollutant is pending, the source will be unsure about whether to include controls for this source as part of its overall compliance strategy. It is unclear whether Section 112(C)(5) would require EPA to establish a new source category prior to applying MACT standards to additional pollutants or if EPA could apply the MACT standards to additional pollutant in an existing source category.

Third, CMA suggests that the petition process should allow for input from the public in setting and evaluating the criteria by which listing/delisting decisions will be made. This is important both in the process development phase as well as in the petition review phase. Public input is needed as EPA develops the petition process to ensure that it is workable and meets the needs of affected groups while meeting the criteria outlined by Congress in Section 112(b) of the Clean Air Act Amendments of 1990. Public input is needed in the petition review phase to ensure that the objective criteria established by EPA are consistently applied from petition to petition.

Fourth, CMA recommends that EPA consult previously established petition procedures under TSCA and SARA to identify areas for improvement. CMA members have extensive experience with these procedures and will send the Agency additional information regarding their strengths and weaknesses.

Finally, CMA expressed concern to Congress that the 17 categories of compounds included as part of the list of hazardous air pollutants are unduly broad. Congress and EPA did not have the resources to evaluate individually the specific compounds, within these categories and to make a separate determination to include them on the hazardous air pollutant list. Therefore, separate petitions would be required to delete specific chemicals within a category of compounds. Because each category may contain as many as several hundred specific compounds many of which may meet the criteria outlined by Congress for being deleted from the hazardous air pollutant list, EPA may be required to evaluate several hundred petitions within a short time period. To lessen the potential petition burden associated with these 17 compound categories, CMA suggests that EPA work closely with the affected industries in developing the procedures for processing petitions involving specific compounds within each of the 17 categories.

To summarize, CMA supports development of an objective, scientifically based petition process for adding and deleting chemicals from the list of hazardous air pollutants. The petition process should provide for timely review and approval of submitted petitions, and should allow for public input during development of the petition process and during review of individual petitions. EPA should consult its own experience under TSCA and SARA when developing the petition procedures. Finally, EPA should work closely with affected industries in developing the procedures for handling petitions for specific substances within the 17 categories of compounds included as part of the list of hazardous air pollutants in the Clean Air Act Amendments of 1990.

V. SOURCE CATEGORY LIST
Status Report on the Development of a List of
Source Categories That Emit the 189 Hazardous Air
Pollutants in The Amendments

EPA Presentation

Mr. Robert Rosensteel
Emission Standards Division
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

SUMMARY

The Emissions Standards Division (ESD), represented by Mr. Rosensteel, provided a presentation to the committee which described the development of the Source Category List required by the Clean Air Act Amendments (CAAA) of 1990. The ESD discussed why and how the list was developed and presented the CAAA requirements to develop a schedule for promulgating emission standards for the categories and subcategories on the list. Following is a brief description of the presentation.

The requirements mandated by the CAAA were presented first. The amendments to the Clean Air Act identify a list of 189 hazardous air pollutants. The Administrator is required to publish a list of all categories and subcategories of sources that emit the hazardous air pollutants. The CAAA specify that a list of source categories shall be published within 12 months of CAAA enactment (November 15, 1991) and that the list shall be reviewed and revised, if appropriate, every 8 years. The CAAA also specify that an emission standards agenda for listed categories and subcategories shall be published within 24 months of enactment (November 15, 1992). The CAAA requirements for listing a source category were reviewed. Additionally, source categories and pollutants with specific requirements were identified.

The technical basis for source category and subcategory identification was explained next. Information from several sources was used to identify source categories and subcategories and to associate them with hazardous air pollutants. Several of the information sources were: emissions databases such as the National Emissions Data System (NEDS) and the Toxics Release Inventory System (TRIS); published chemical production and consumption data linked with emission factors developed by the Emission Standards Division (ESD); the Hazardous Organic NESHP project; and, other EPA studies which include source assessments, background information for proposed New Source Performance Standards (NSPS) and "Locating and Estimating Emissions" documents.

The format of the list was presented next. The list includes 18 industry groups, with source categories and subcategories and their respective pollutants in each group. There are 766 source categories and subcategories on the list.

The presentation was concluded with the schedule for emissions standards development. The criteria for prioritizing emission standards promulgation was discussed and it was noted that a schedule for prioritized emission standards must be published within 24 months (Nov, 15, 1992) of CAAA enactment. Emission standards must be developed for 40 categories or subcategories within 2 years, for 25% of the listed categories and subcategories in 4 years, for 50% of the listed categories and subcategories within 7 years, and for all listed categories and subcategories within 10 years.

Air Toxics Source Category Listing

Presentation to

NAPCTAC

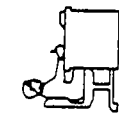
**U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emission Standards Division**

January 29, 1991

PRESENTATION OUTLINE

- **Title III Requirements of the 1990 Clean Air Act Amendments**
- **Technical Basis for Source Category Identification**
- **Source Category List**
- **Emission Standards Development Schedule**

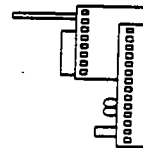
TITLE III REQUIREMENTS OF THE 1990 CLEAN AIR ACT AMENDMENTS



**Publish a list of Source Categories
within 12 months of CAAA
enactment.**



**Review and revise list every
8 years.**



**Publish Emission Standards
Agenda for listed categories
within 24 months.**

CAAA REQUIREMENTS FOR LISTING SOURCE CATEGORIES

- **List All Major and Area Source Categories and Subcategories**
- **Area Source Category Listing Requirements**
- **Pollutants with Specific Requirements**
- **Category Specific Requirements**

CONSIDERATIONS IN DEFINING A SOURCE CATEGORY

- **Only Source Categories previously defined in EPA studies were listed.**
- **No de minimis levels were considered in the decision to list a Source Category.**
- **Currently listed categories and subcategories are not classified according to area and major source definitions.**

AREA SOURCE CATEGORY LISTING REQUIREMENTS

- **List shall include sufficient categories to ensure regulation of 90% of area source emissions.**
- **Regulations shall include the 30 HAPs which present the greatest threat to public health in the largest number of urban areas.**

POLLUTANTS WITH SPECIFIC REQUIREMENTS

- **Alkylated Lead Compounds**
- **Polycyclic Organic Matter**
- **Hexachlorobenzene**
- **Mercury**
- **Polychlorinated Biphenyls**
- **2,3,7,8-Tetrachlorodibenzofurans**
- **2,3,7,8-Tetrachlorodibenzo-p-dioxin**

CATEGORY SPECIFIC REQUIREMENTS

- **Research or Laboratory**
- **Boat Manufacturing**
- **Oil and Gas Production Wells**

TECHNICAL BASIS FOR SOURCE CATEGORY IDENTIFICATION

- **National Emissions Data System**
- **Production/Consumption Data for Organic Chemicals**
- **Synthetic Organic Chemical Manufacturing Industry**
- **Other EPA Studies**
- **Toxic Release Inventory System**
- **National Air Toxics Information Clearinghouse**

**CATEGORY IDENTIFICATION
USING
NATIONAL EMISSIONS DATA SYSTEM**

- **Speciation Profiles for VOC
and PM emissions were used to
estimate air toxics constituents**

CATEGORY IDENTIFICATION USING ORGANIC CHEMICAL PRODUCTION/CONSUMPTION DATA

- **Published chemical production and consumption data linked with emission factors developed by ESD**
 - **SRI Directory**
 - **Mannsville Chemical Synopsis**
 - **Chemical Marketing Reporter**

Synthetic Organic Chemical Manufacturing Industry

- **Standards of Performance for
Equipment Leaks of VOC**
- **Industrial Organic Chemical Use
Trees**

CATEGORY IDENTIFICATION USING OTHER EPA STUDIES

- **Preliminary Source Assessments**
- **Source Assessments**
- **Background Information for Proposed NSPS Regulations**
- **Locating and Estimating Emissions Documents**

CATEGORY IDENTIFICATION USING TOXIC RELEASE INVENTORY SYSTEM

- **Annual reporting required by owners/operators of facilities that manufacture/process >25,000 lbs/yr or use >10,000 lbs/yr of listed toxic chemicals**

CATEGORY IDENTIFICATION USING TOXIC RELEASE INVENTORY SYSTEM

- **Categories identified by
specific chemical name and
grouped under Production and
Use Activities (TRIS)**

CATEGORY IDENTIFICATION USING NATIONAL AIR TOXICS INFORMATION CLEARINGHOUSE

- **Source Testing Information was sorted according to pollutant and test descriptions were then reviewed for potential source categories.**

SOURCE CATEGORY LIST

- **The draft list includes 766 Source Categories and Subcategories combined in 18 broad industry groups.**

SOURCE CATEGORY - INDUSTRY GROUPS

- **Fuel Combustion**
- **Nonferrous Metals**
- **Ferrous Metals**
- **Mineral Products Processing
and Use**
- **Petroleum Refineries**

SOURCE CATEGORY - INDUSTRY GROUPS **(continued)**

- **Petroleum and Gasoline
Production and Marketing**
- **Surface Coating Processes**
- **Waste Treatment & Disposal**
- **Agricultural Chemicals
Production and Use**
- **Fiber Production Processes**

SOURCE CATEGORY - INDUSTRY GROUPS **(continued)**

- **Food and Agriculture Industry**
- **Pharmaceutical Production Processes**
- **Polymers & Resins Production**
- **Production & Use of Inorganic Chemicals**
- **Production of Synthetic Organic Chemicals**

SOURCE CATEGORY - INDUSTRY GROUPS (continued)

- **Radionuclide Emitters**
- **Miscellaneous**
- **Production and Use Activities
(TRIS)**

**PUBLICATION OF PRIORITIZED EMISSION
STANDARDS SCHEDULE**

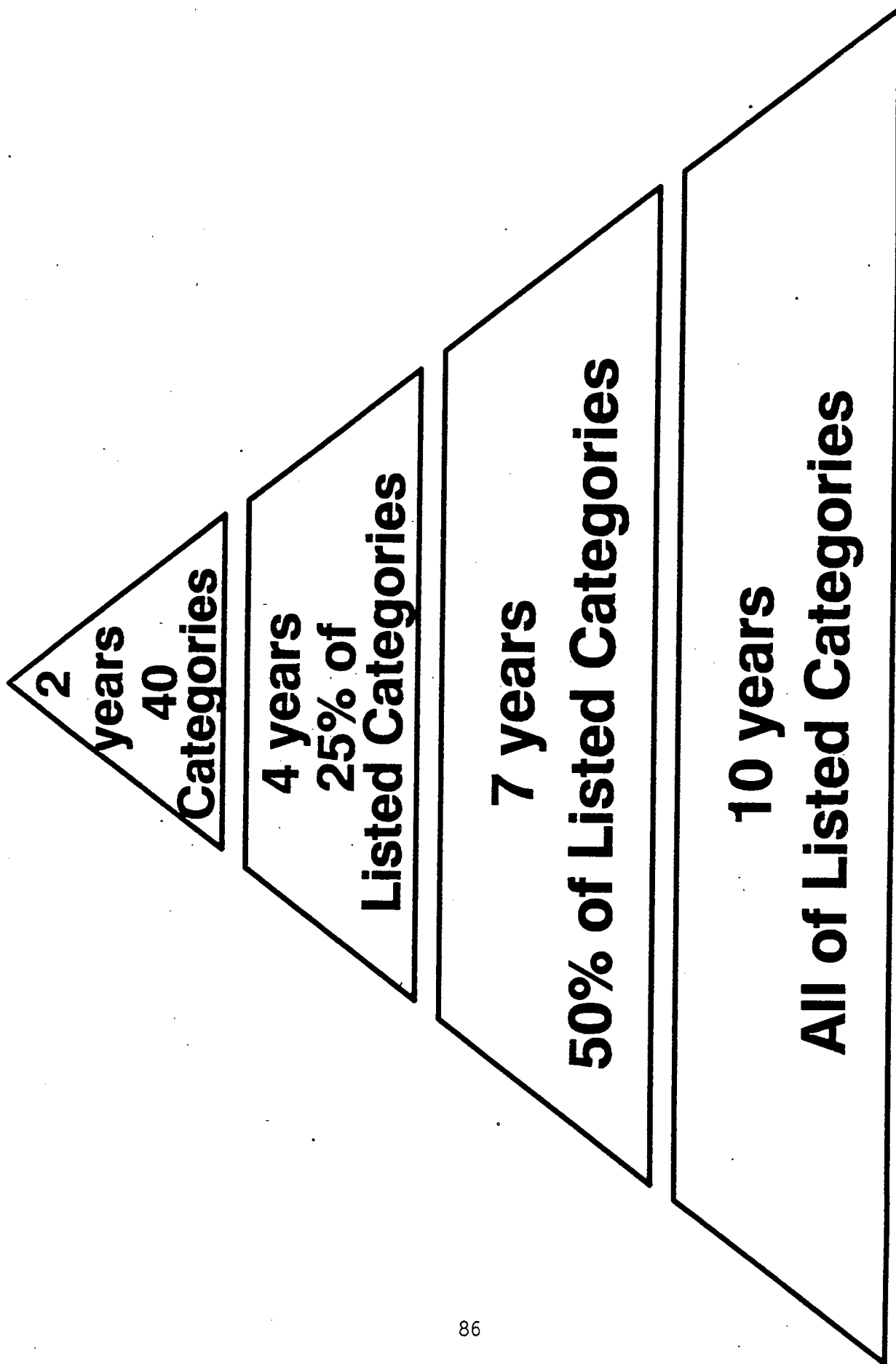
**The Administrator shall
publish a schedule for
promulgation of emission
standards for each listed
category and subcategory
within 24 months (Nov. 15,
1992) of CAAA enactment.**

CRITERIA FOR PRIORITIZING EMISSION STANDARDS PROMULGATION

**Adverse effects on public
health & the environment**

**Quantity and Location
of category emissions**

**Efficiency of grouping categories
according to pollutants, processes
or technologies**



**EMISSION STANDARDS DEVELOPMENT
SCHEDULE**

SOURCE CATEGORY LIST REVISIONS

- **The source category list must be reviewed and revised (if appropriate) at least every eight years.**
- **New categories may be added to the list at any time.**
- **A listed category may be deleted if it meets at least one of three criteria.**

CRITERIA FOR CATEGORY DELETIONS

A category may be deleted from the list upon petition by any person or on the Administrator's own determination if one of the following three criteria is satisfied.

[Any petition must be granted or denied within 1 year]

FIRST CRITERIA FOR CATEGORY DELETIONS

Sufficient evidence supports the removal of a listed HAP. [Section 112 (b) (3) (C) or (D)]

AND

The removed HAP is the only HAP emitted by the category under consideration for deletion

SECOND CRITERIA FOR CATEGORY DELETIONS

No source in the category (or group of area sources) emits any HAP in such quantities which may present a lifetime cancer risk of greater than 1:1,000,000 to the MEL.

THIRD CRITERIA FOR CATEGORY DELETIONS

**No source in the category emits
any HAPs in quantities which
may exceed a level required to:**

- Protect public health**

AND

- Prevent adverse environmental
impacts**

DISCUSSION

After the presentation, EPA solicited the committee for questions or comments regarding the list. Questions and comments posed by the committee and responses to them are summarized below:

Ms. Deborah Sheiman asked how many source categories are represented in the SOCMCI group, and how they will be counted with respect to meeting the 25% and 50% standards development schedule. Mr. Rosensteel replied that there are approximately 400 source subcategories in the SOCMCI group and each subcategory in SOCMCI for which an emission standard is promulgated would be counted. Ms. Sheiman expressed concern that the regulation of the SOCMCI group alone would meet the CAAA requirements mandating development of regulations for 50% of the listed categories, and that legally EPA would not have to promulgate any additional regulations for 7 years. Mr. James Weigold assured Ms. Sheiman that EPA has no intentions of stopping regulation development with the HON. EPA intends to do as many regulations as resources will allow and will proceed through the list as rapidly as possible.

Mr. Ralph Hise asked if a single plant could feasibly belong to several source categories on the list and thus be subject to several regulations. Mr. Weigold (EPA/ESD) responded that it was very possible that one chemical plant may belong to many different subcategories and therefore be subject to several regulations. However, it is EPA's intention to group categories or subcategories under one regulation when similarities in technologies and processes exist. Mr. Hise asked if it was feasible that a particular plant, falling under several source category definitions, would be actually controlling all of its emissions before regulations were developed for all of its categories, since all of the plant's emissions may be controlled already due to the regulation of one source category alone. EPA responded that it was possible.

Mr. William Dennison inquired whether EPA would evaluate State inventory data and the hot spot program in California for possible source categories to add to the list. Mr. Rosensteel answered that EPA is aware of the programs and has reviewed some of the California data. However, the information was not available prior to the publication of the preliminary draft document.

Mr. Paul Arbesman asked whether all the 766 source categories and subcategories were emitting more than one of the pollutants on the 189 CAAA list and whether there was specific documentation linking each source category and pollutant. Mr. Rosensteel assured Mr. Arbesman that each pollutant linked with a source category has documentation although EPA may not have found all possible pollutants associated with a particular source

category or subcategory. Mr. Rosensteel requested comments on the list from industry and other interested parties.

Mr. Arbesman also asked about the distinction between the definitions of source category and subcategory and how these would be treated in terms of the regulatory agenda. Mr. Rosensteel responded that both categories and subcategories will be treated equally in terms of the regulatory agenda but no clear separation between them currently exists. The efficiency of grouping categories and subcategories will be addressed during the development of regulations.

Dr. John Pinkerton asked whether the EPA would publish the relative ranking of the listed categories within the remaining 18 months. Mr. Weigold responded that the ranking and final list will be published simultaneously and it would be accomplished within the time frame mandated by the CAAA. Mr. Pinkerton asked what criteria would be used to develop the ranking. Mr. Rosensteel responded that emissions will be estimated for each category and subcategory and location information will be used with the emissions data to predict possible exposure. The exposure estimates will be used in conjunction with health effects data to prepare relative rankings of all the source categories. These relative rankings as well as considerations concerning the efficiency of grouping categories according to pollutants, processes, or technologies will be used to determine where each category or subcategory will be placed on the emission standards schedule.

Ms. Vivian McIntire asked what would happen if a listed source category did not emit one of the 189 HAPs associated with it. Mr. Weigold responded that regulatory allowances will be made under such circumstances if sufficient documentation supports such an allowance.

Mr. William O'Sullivan asked whether minor sources would now be considered area sources under Title III and thus subject to operating permit requirements. EPA responded that all major and area sources listed will be subject to regulation and currently there is no distinction made between the listed categories based upon a major or area source definition.

Dr. Patrick Atkins asked whether the specific requirements for the seven Great Lakes pollutants were time-related only or whether there were further requirements specific for those pollutants. Mr. Rosensteel explained that source categories emitting at least 90% of each pollutant must be identified within 5 years and regulations developed for those source categories within 10 years of the CAAA enactment.

Mr. Charles Collins asked how EPA would address questions from industry about exemptions for small sources. Mr. Weigold responded that Congress obviously went to great lengths to specify that both major and area sources will be subject to

regulation under Title III. Area sources are defined as any source that is not a major source and will be subject to either MACT or GACT control requirements. Specific exemptions will be made only upon development of a regulation.

Mr. Collins also inquired how EPA will evaluate emission estimates provided by industry, especially since test methods are not available for all of the 189 HAPs. EPA responded that research must be conducted to develop testing protocols and this is one of the issues being addressed by the early reductions program.

STATEMENT OF
ELIZABETH FISHER
ON BEHALF OF
THE CHEMICAL MANUFACTURERS ASSOCIATION
BEFORE THE
NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE
ON THE
PUBLICATION OF A LIST OF SOURCE CATEGORIES
UNDER SECTION 112 OF TITLE III OF THE
CLEAN AIR ACT AMENDMENTS OF 1990

JANUARY 29, 1991

CHEMICAL MANUFACTURERS ASSOCIATION
TESTIMONY BEFORE THE NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE ON THE
PUBLICATION OF A LIST OF SOURCE CATEGORIES
UNDER SECTION 112 OF TITLE III OF THE
CLEAN AIR ACT AMENDMENTS OF 1990

My name is Elizabeth Fisher. I am Environmental Manager of Air and SARA Programs for the North American Region Environmental Affairs Division of Rohm and Haas Company. I am speaking to you today on behalf of the Chemical Manufacturers Association (CMA) where I serve as a member of the Air Toxics Work Group. CMA is a nonprofit trade association whose member companies represent over 90 percent of the production capacity of basic industrial chemicals in the United States. We are pleased to have this opportunity to present our views to the National Air Pollution Control Techniques Advisory Committee.

CMA supported the 1990 amendments to Section 112 of the Clean Air Act including those provisions calling for EPA to develop a list of categories and subcategories of major sources and area sources of hazardous air pollutants. CMA agrees with EPA that this is an essential step toward informing sources, the public, and regulatory agencies about the intended scope of the NESHA program.

In addition to publishing the list of the source categories and subcategories of major sources to be regulated, EPA also plans to publish the schedule for issuing regulations for the listed source categories and subcategories. CMA believes this is also an important step to allow affected industry and regulatory agencies to schedule resources accordingly.

CMA has several recommendations regarding EPA's approach for defining source categories and subcategories for the chemical manufacturing industry. Our recommendations fall into two main areas.

How source categories and subcategories are defined are important not only for determining which sources are to be regulated and when, but also for MACT standards development, delisting of source categories, and residual risk evaluations. CMA recommends that EPA consider the implications of a source category definition on these activities prior to publication of its list.

Second, in order for EPA to meet the statutory requirement of the Clean Air Act amendments of regulating all initially listed source categories of hazardous air pollutants within 10 years, EPA must prioritize source categories and subcategories for regulatory development over 10 years. Likewise, other parties affected by these regulations, including sources to be regulated and the regulatory agencies responsible for administering the regulations, have a similar interest in ensuring that source categories are properly prioritized and phased in over the ten years. CMA recommends that EPA consider the interests of all affected groups in setting priorities and rulemaking schedules for the list of source categories and subcategories.

The remainder of my comments will elaborate on these two points.

The way in which EPA defines source categories and subcategories is relevant to a number of amended Section 112 provisions. First, it establishes the group of sources for which a MACT standard must be developed and the sources upon which each standard is based (Section 112 (d)). Second, it can impact the schedule under which EPA promulgates regulations for a particular group of sources (Section 112 (e)). Third, it establishes the group of sources for which residual risk determination is required and to which a residual risk standard may apply (Section 112 (f)(2)). Finally it establishes the group of sources that may be eligible for deletion from the list of source categories based on a demonstration of negligible risk (Section 112 (c)(9)).

Before going on, it is important to point out the distinction between the term "source category" and "subcategory". It is unclear from the materials presented by EPA how they intend to differentiate between source categories and subcategories, particularly in relation to the chemical manufacturing industry. In the EPA document, "Documentation for Developing the Source Category List," EPA lists approximately 400 "source categories" under the industry group, Production of Synthetic Organic Chemicals. Yet, in a separate document to be presented by EPA later in this meeting, entitled "Overview of the Hazardous Organic NESHA Project," EPA indicates that a single MACT standard is being developed that will apply to almost 400 individual subcategories within the synthetic organic chemical manufacturing industry. These chemical production processes described as source categories in the former document are essentially the same as the list of subcategories presented in the latter document. Thus, it appears that EPA has not decided whether to refer to these individual production processes as source categories or subcategories.

These terms "source category" and "subcategory" are used interchangeably in the Section 112 provisions dealing with MACT standards and residual risk standards; however, the provisions for deleting categories from the list refer only to source categories and not subcategories. Therefore, the distinction between these terms goes beyond semantics and could significantly impact the way in which some sources are regulated under the Clean Air Act.

How broadly or narrowly EPA defines source categories and subcategories is relevant for each of the Section 112 provisions cited above, since an action can be triggered on the basis of a contribution of a single source in the category or subcategory. For example, the existing sources MACT standard for an entire category or subcategory is based on the best controlled sources in the category or subcategory. Sources in the category or subcategory should therefore employ similar processes and be amenable to similar controls.

In the case of residual risk standards, the Clean Air Act Amendments of 1990 require EPA to evaluate residual risk of sources in requirements for each category or subcategory having a source where the risk to the most exposed individual exceeds one in one million. A very broadly defined source category or subcategory could result in imposition of additional controls at significant costs on hundred's of sources that do not exceed the risk criteria simply because as few as one source in the broad category exceeds acceptable residual risk criteria.

Also, for a source category to qualify for removal from the list, all sources within the category must demonstrate that risk to the most exposed individual does not exceed one in one million. Defining the category very broadly greatly decreases the chances that any source category will qualify for deletion from the list.

How EPA defines source categories and subcategories also has a significant impact on how affected industries and regulatory agencies implement the regulations. This is particularly true for an industry with as complex and diverse facilities as the chemical manufacturing industry. In fact, CMA believes that for the chemical manufacturing industry to be able to meet the compliance deadlines for MACT standards provided for in the Clean Air Act, it is essential that EPA subdivide the industry into smaller groups that can be prioritized for purposes of phasing in regulations over a reasonable time frame of several years.

There are two primary reasons why CMA believes the chemical manufacturing industry should be broken down into smaller groups for purposes of developing, prioritizing, and phasing in regulations.

First, CMA is concerned that limitations in available engineering resources and supply of control equipment will reduce the ability of its member companies to comply with MACT standards within the three year compliance deadline if MACT standards are applied to all chemical manufacturing processes at one time. Based on a recent survey of CMA members, CMA projects that MACT standards for the chemical industry alone will result in a four-to-five fold increase in annual demand for control equipment. Additional demand for control equipment during the same time frame will result from other MACT standards as well as other Clean Air Act programs, State and local regulations, and voluntary programs.

Second, CMA is also concerned that the permitting demand created by such a broad application of MACT standards at one time will overload the permitting resources at the Federal, State, and local levels. Not only will the MACT standards trigger the need for permits for as many as several thousand sources within a time frame of less than three years, the permits involved will be among the most complex that Federal, State, and local agencies will be called upon to process. We believe that these regulatory agencies have a similar interest in phasing in the regulation over the chemical industry to make the permitting load more manageable.

For these reasons, CMA has already recommended to EPA that they subdivide the chemical manufacturing industry into subsets for purposes of prioritizing and phasing in regulations. It is our understanding that EPA is considering this recommendation and is currently evaluating information provided by us in support of our recommendation. CMA believes that the method described by EPA in its draft document, "Documentation for Developing the Source Category List" is a reasonable starting point for identifying subsets within the chemical manufacturing industry that can then be grouped and prioritized, as needed, to meet the Clean Air Act deadlines for issuing regulations for all source categories and subcategories within 10 years.

CMA recommends to EPA that the following objectives be met in the criteria developed by EPA for prioritizing subsets of the chemical manufacturing industry for purposes of phasing in regulations.

First, the criteria for prioritizing subsets of the industry for regulation should focus earliest application of control technology in industry subgroups with the highest potential for adverse health risk. This objective is consistent with guidance given by Congress (Section 112 (e)(2)(A) and (B)) that pollutant toxicity and quantity and location of emissions be considered in setting the regulatory agenda.

Second, the criteria for prioritizing subsets should allow EPA to meet statutory deadlines, taking into account the amount of resources needed to make the required rulemaking demonstrations. This objective is consistent with guidance given by Congress in Section 112 (e)(2)(c) on efficiency of grouping categories for regulatory development.

Third, the criteria should consider the ability of permitting authorities, namely State and local regulatory agencies, to process permit applications for MACT controls in a timely manner. CMA believes this objective can be met if a prioritization scheme results in application of control requirements over roughly even numbers of facilities over time.

Fourth, the criteria should allow the industry to achieve compliance deadlines through effective resource procurement and management. This objective also can be met if the prioritization scheme results in application of control requirements over roughly even numbers of facilities over time.

Earlier this month, CMA submitted information to EPA on the need for phasing in MACT regulations over the chemical manufacturing industry over several years. CMA is continuing to collect and evaluate information for EPA to use in developing a reasonable approach for accomplishing this purpose and will supply this information as soon as it is available.

This concludes my remarks. I'll be happy to answer any questions.

CLEAN AIR WORKSHOP
March 27, 1991
Houston, TX

7:00-8:00 a.m. Registration

8:00-8:10 Introduction

8:10-9:10 Nonattainment: attainment deadlines, NOx-VOC trade-offs, offsets, boundaries, percent reductions, sanctions (Jack McClure, Shell Oil; Brian Taranto, Exxon Chemical Americas)

9:10-10:55 Air Toxics: MACT, credit for early reductions, residual risk, source categories, accidental releases (Danny Anderson, First Chemical; Dave Gustafson, Dow Chemical; Joe Hovious, Union Carbide; Liz Fisher, Rohm & Haas; Paul Jann, E.I. du Pont de Nemours & Co.; Bruce Davis, Exxon Chemical Americas)

10:55-11:10 Break

11:10-12:00 Permits: coverage, fees, operational flexibility, compliance plan, external review, shield (Vivian McIntire, Tennessee Eastman Co.; R. Dean Cooper, Dow Chemical)

12:00-1:10 Lunch (Guest Speaker to be announced)

1:10-2:40 Scenario I: panel discussion of the impacts of the new requirements on a hypothetical plant in a nonattainment area

2:40-2:55 Break

2:55-4:15 Scenario II: panel discussion of the impacts of the new requirements on a hypothetical plant in an attainment area

4:15-5:00 Enforcement (Kathy Bailey, CMA)

5:00 Adjourn

DISCUSSION

Mr. Paul Arbesman asked Ms. Fisher how many permits CMA envisioned being required under the present framework. Ms. Fisher said the CMA would send estimates to the Committee.

Mr. William Dennison, formerly of South Coast Air Quality Management District (SCAQMD), conceded that the CAAA were complicated by a dearth of permitting engineers, and might lead to a new approach to permit processing. He asked Ms. Fisher if CMA could quantify the impact over the next 5 years of the implementation of HON on the CMA's substitution/reduction program. Ms. Fisher agreed it would have an effect, and further noted that even the program to phase out CFC's had a 10-20 year time frame.

SOURCE CATEGORIES **AND SUBCATEGORIES**

- WHAT SOURCES REGULATED/ MACT STANDARD BASE
- SCHEDULE OF REGULATIONS
- RESIDUAL RISK EVALUATIONS
- DELISTING OF SOURCE CATEGORIES

SOCMI CATEGORY DIVISIONS

FOR

- DEVELOPING
- PRIORITIZING
- PHASING-IN
REGULATIONS

LIMITS

- ENGINEERING RESOURCES/EQUIPMENT
SUPPLY/DEMAND
- PERMITTING DEMAND

OBJECTIVES

- HIGHEST REDUCTION IN POTENTIAL
ADVERSE HEALTH RISK
- EFFICIENCY - RESOURCES TO MEET
STATUTORY DEADLINES
- TIMELINESS - PERMITS
- EFFECTIVENESS

UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

AGENCY ACTION ON PROPOSED)	Docket No.
CATEGORIZATION OF SOURCES)	A-90-49
OF HAZARDOUS AIR POLLUTANTS)	January 29, 1991

**Statement of the Utility Air Regulatory Group to the
National Air Pollution Control Techniques Advisory Committee**

My name is Dennis Braswell, and I am a lawyer with the law firm of Hunton & Williams, from Richmond, Virginia. Today I appear on behalf of the Utility Air Regulatory Group ("UARG"). UARG is a voluntary, nonprofit, unincorporated ad hoc group of electric utilities, the Edison Electric Institute (EEI), the National Rural Electric Cooperative Association (NRECA), and the American Public Power Association (APPA). The vast majority of existing electric power plants in this nation are owned or operated by the individual electric utility members of UARG or by others that are members of EEI, APPA, or NRECA.

Section 112(c) of the Clean Air Act requires EPA to categorize major sources of hazardous air pollutants within one year and most area sources within five years. Pursuant to a schedule set out in § 112(e), EPA must then establish emission standards for each category and subcategory. In addition, under § 112(n), Congress has directed EPA to perform a study of the hazards to public health reasonably anticipated to result from emissions by electric utility steam generating units of hazardous air pollutants listed under § 112. EPA is required to complete the study by November 15, 1993 (within three years of the date of enactment of the 1990 Amendments). Following completion of the study, EPA is to regulate electric utilities if "appropriate and necessary." Given these statutory schedules, the question arises whether electric utilities can or should be categorized or regulated before the study is completed. As a matter of law and sound policy, they should not.

By requiring EPA to conduct a study of the hazards to public health from electric utility emissions and by giving EPA three years to complete that study, Congress has given electric utilities special treatment under § 112. As a matter of law, the study provisions of § 112 need to be read in harmony with that section's categorization and standard-setting provisions. The best interpretation of these provisions is that EPA is not required to categorize or regulate electric utilities under Title III until after the study is completed, if at all.

Postponing categorization and standard-setting decisions until after the electric utility study is completed also makes sense as a matter of policy. Any effort at categorization and standard-setting before the study is completed will be wasted if the results of the study indicate that there is no regulatory concern for hazardous emissions from electric utility facilities. Even if the study indicates that some regulation is necessary, information from the study -- such as emission rates, efficiencies of various control technologies, and relationships between fuel type and pollutants emitted -- will be critical in defining appropriate categories and setting control technology requirements.

Thus, as a matter of law and policy, categorization and standard-setting decisions for electric utility facilities should be delayed until EPA has completed the study of hazards to public health associated with hazardous emissions from electric utilities. Any decisions made before the study is completed are not required by the statute, and will likely result in an unnecessary expenditure of EPA's time and resources.

VI. EARLY EMISSION REDUCTION
STATUS REPORT ON IMPLEMENTATION OF THE TITLE III
PROVISIONS FOR EARLY REDUCTION TO DEFER APPLICATION
OF MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT)

EPA PRESENTATION

David Beck
Emission Standards Division
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

SUMMARY

The purpose of this briefing was to introduce the NAPCTAC Committee to the early reduction provisions of the Clean Air Act and describe the status of the Emission Standards Division's project to develop regulations to implement these provisions (see attached charts).

The briefing began with an overview of the early reduction provisions, which are contained in section 112(i)(5) of the Clean Air Act, as amended. Under these provisions, an existing source may obtain a six-year extension to the compliance date of an applicable MACT standard in return for achieving early reductions of hazardous air pollutants (HAPs) at the source. The source must achieve, prior to proposal of an applicable MACT standard, a 90% (95% for particulate HAPs) reduction from HAP emissions in a base year not earlier than 1987 in order to qualify for the extension. Qualifying sources would be issued a permit specifying an alternative emission limitation, in lieu of the MACT standard, which reflects continued use of the controls that achieved the 90% (95%) reduction. Sources not able to achieve reductions prior to proposal of an applicable MACT standard still could qualify for the extension if the source made an enforceable commitment, prior to proposal of the standard, to achieve the reductions by January 1, 1994. In the provisions, States are given the right to require emission reductions in excess of 90% (95%) as a condition of granting a compliance extension. A chart was shown which illustrated the potential benefits of a source reducing HAP emissions early instead of meeting a MACT standard.

Next the planned outputs of the project were described. The regulation will be the primary output and will tell a source how to demonstrate achieving the required emission reduction and make application for the extension. Additionally, EPA will publish a document summarizing proper emission estimating methods for several source categories and a protocol for source owners or operators to use in validating source test methods.

The bulk of the briefing centered on discussing several key issues that, when resolved, largely would determine the characteristics of the implementing EPA program. These issues are:

- 1) What is a "source" for the purposes of the early reduction program? That is, what entity within a plant site can or must be part of an early reduction demonstration in order to qualify for an extension?

- 2) What is an "enforceable commitment" and what are the consequences of failing to comply with the terms of an enforceable commitment?
- 3) What information should be required to demonstrate emission reductions?
- 4) How will high-risk pollutants be treated? What chemicals should be on the list of high-risk pollutants? (In the early reduction provisions, the Administrator is instructed to limit offsetting reductions from other HAPs in counting toward a 90% (95%) reduction of certain high-risk pollutants. Also, the Administrator must, by a rule, list high-risk pollutants that will be subject to the offset limit).
- 5) How will the program be administered? What procedures will be followed? How will the States be integrated into the process?

Each issue was explained as well as possible solutions. It was noted that EPA had not yet made decisions with respect to these issues.

Final remarks were addressed to the very tight timeline for completion of the project, which calls for proposal of the regulations at the end of March and promulgation in October or November of 1991.

**COMPLIANCE EXTENSIONS
FOR EARLY REDUCTIONS OF
HAZARDOUS AIR POLLUTANTS**

JANUARY 29, 1991

BRIEFING OUTLINE

A. EARLY REDUCTION PROVISIONS

B. POTENTIAL BENEFITS

C. EPA PLANNED OUTPUTS

D. ISSUES

E. SCHEDULE

EARLY REDUCTION PROVISION

SECTION 112(i)(5)

**FOR EXISTING SOURCE THAT
DEMONSTRATES:**

- **90% (95%) REDUCTION OF HAP**
- **FROM VERIFIABLE AND ACTUAL
BASELINE (1987)**
- **PRIOR TO PROPOSAL OF MACT STD.**

**THE ADMINISTRATOR OR STATE
SHALL ISSUE A PERMIT:**

- **ALLOWING AN ALTERNATIVE
EMISSION LIMITATION**
- **REFLECTING CONTINUED 90% (95%)
REDUCTION**
- **FOR A PERIOD OF 6 YEARS**

<p>SECTION 112(i)(5) CONTINUED</p>
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ADDITIONAL PROVISIONS

- **REDUCTIONS AFTER PROPOSAL ARE ALLOWED IF, PRIOR TO PROPOSAL, SOURCE MAKES AN "ENFORCEABLE COMMITMENT" TO ACHIEVE REDUCTIONS BEFORE JANUARY 1, 1994**
- **STATES MAY REQUIRE REDUCTIONS IN EXCESS OF 90% (95%) AS A CONDITION OF GRANTING AN EXTENSION**

EMISSIONS COMPARISON EARLY REDUCTIONS VS. MACT

TIME	CONTROL SCENARIO	
(YEARS)	MACT	EARLY RED.
-1	100	10
+1	100	10
+2	100	10
+3	100	10
+4	2	10
+5	2	10
+6	2	10
+7	2	10
+8	2	10
+9	2	10
TOTALS	412	100

MACT = 98%

PLANNED OUTPUTS

REGULATION

- **TELL HOW TO DEMONSTRATE REDUCTION**
- **GIVE PROCEDURES TO FOLLOW**

ADDITIONAL INFORMATION

- **TEST METHODS, TEST PROTOCOL**
- **EMISSION ESTIMATING DOCUMENT**

ISSUES

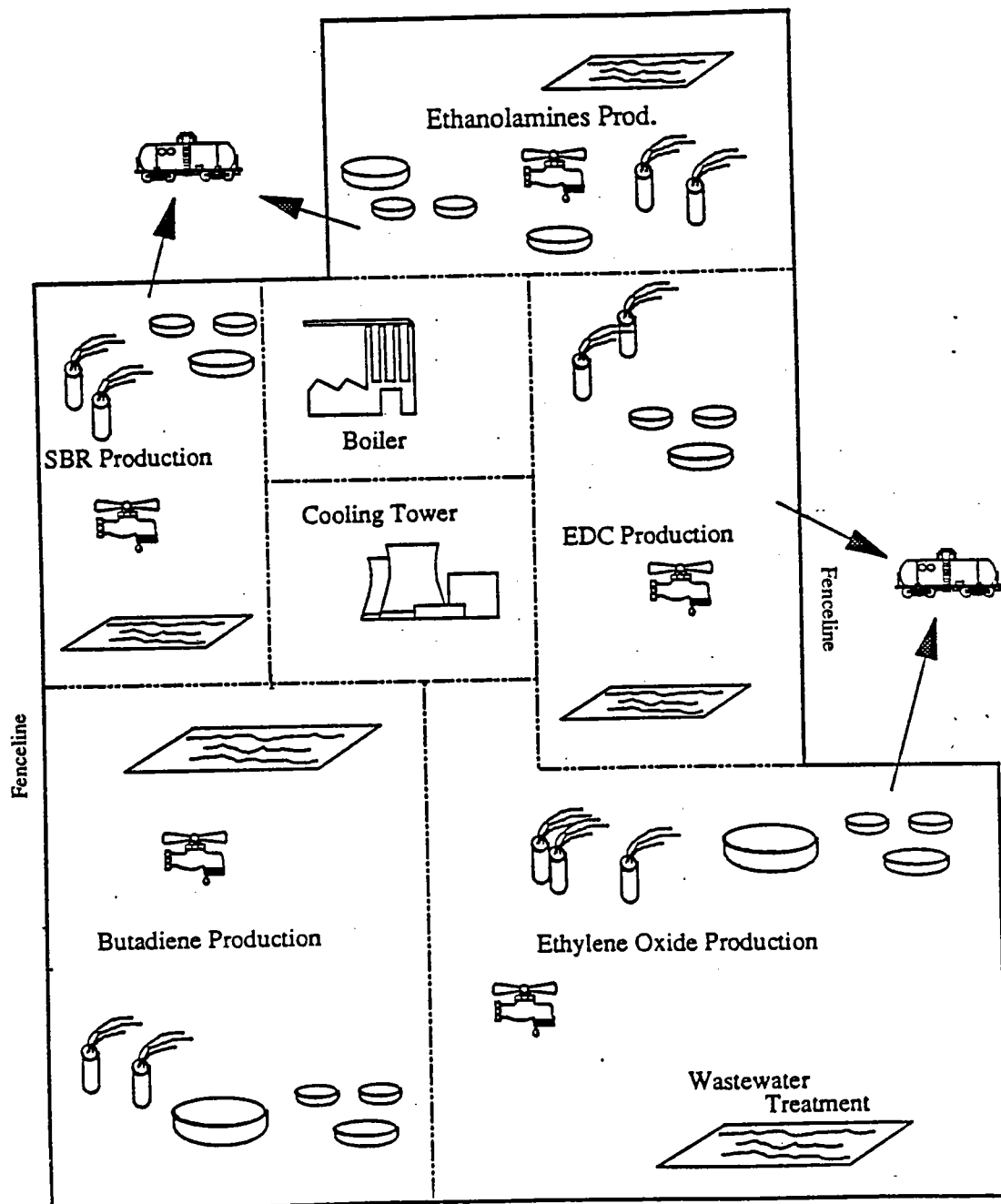
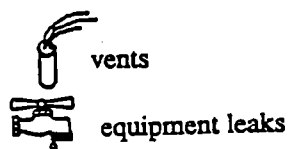
- **DEFINITION OF SOURCE**
- **ENFORCEABLE COMMITMENTS**
- **REDUCTION DEMONSTRATION**
 - BASELINE**
 - POST-CONTROL**
- **HIGH RISK POLLUTANTS**
- **PROGRAM ADMINISTRATION**

DEFINITION OF SOURCE

"SOURCE" OPTIONS

- **ENTIRE CONTIGUOUS FACILITY**
- **FACILITY COVERED BY A MACT STD.**
- **AVERAGE ACROSS SEVERAL FACILITIES
COVERED BY ONE MACT STD.**
- **AVERAGE ACROSS SEVERAL FACILITIES
COVERED BY MULTIPLE MACT STDs.**
- **ALLOW APPLICANT TO DEFINE
A "POOL" OF EMISSION POINTS**

PLANT CONTAINING SEVERAL SOURCE CATEGORIES



ENFORCEABLE COMMITMENTS

APPLICABILITY

- **APPLICABLE TO SOURCES SUBJECT TO
EARLY MACT STANDARDS**

REQUIREMENTS

- **MAKE COMMITMENT BEFORE PROPOSAL**
- **COMMIT TO ACHIEVING REDUCTION
PRIOR TO JANUARY 1, 1994**

QUESTIONS

- **WHAT HAS TO BE IN AN
ENFORCEABLE COMMITMENT?**
- **WHAT HAPPENS IF THE SOURCE FAILS?**

REDUCTION DEMONSTRATION

DOCUMENTATION

- **BASELINE AND POST-CONTROL
EMISSION ESTIMATES**
- **CRITICAL PART OF PROCESS**
- **TOXICS RELEASE INVENTORY DATA
NOT SUFFICIENT**
- **POINT BY POINT DELINEATION
OF EMISSIONS**

QUESTIONS

- **WHAT SUPPORTING INFORMATION
SHOULD BE REQUIRED?**
- **WHAT ROLE FOR TESTING?**

HIGH RISK POLLUTANTS

PROVISION

- **HIGH-RISK POLLUTANTS PRESENT
ADVERSE HEALTH EFFECTS AT LOW
EXPOSURES**
- **ADMINISTRATOR SHALL LIMIT USE OF
OFFSETTING REDUCTIONS OF OTHER
HAP AS COUNTING TOWARD 90 PERCENT
REDUCTION OF HIGH-RISK POLLUTANTS**

IMPLEMENTATION

- **LIST OF HIGH-RISK CHEMICALS**
 - **CHLORINATED DIOXINS AND FURANS**
 - **OTHERS?**
 - CARCINOGENICITY**
 - OTHER EFFECTS**
- **HOW TO LIMIT OFFSETS**

ADMINISTERING THE PROGRAM

- **COORDINATION WITH OTHER VOLUNTARY PROGRAMS**
- **SETTING UP PROCEDURES**
 - **ENFORCEABLE COMMITMENTS**
 - **PERMIT APPLICATIONS**
 - **REVIEW, TIMING**
- **COORDINATION WITH THE STATES**
- **ENFORCEMENT**

SCHEDULE

PROPOSAL

end of MARCH

PROMULGATION

OCT./NOV.

DISCUSSION

Following the EPA presentation, Dr. John Pinkerton of the Committee asked how the emission reduction would be calculated for a source. An annual basis was mentioned in the presentation, but could emissions on a rate basis, such as pounds per ton of production be used? Mr. Beck responded that EPA likely would require emissions to be calculated on an annual basis because emission estimates based on concentrations or production introduced variables that may make administration of the program difficult. Dr. Pinkerton asked how we would account for variations in production levels, since emissions would vary with production. The EPA response was that in establishing a base year emission estimate a source is required by the Clean Air Act provisions to show that emissions in the base year are not artificially or substantially greater than emissions in other years prior to implementing controls. Therefore, the estimate must represent normal operation of the source, which will minimize the chance for production variations to produce "paper" reductions.

Mr. William O'Sullivan suggested that EPA use existing State permitting processes instead of writing Federal permits for the early reduction program. Mr. Weigold responded that although we certainly are planning to involve the States in the early reduction program, one problem with using existing State programs is that they are not federally enforceable. Also, at the beginning of the program, the task is to develop enforceable commitments, not to write permits. Permits for sources making early reductions would not have to be issued until later, after EPA has federal permitting regulations promulgated. It is possible that at such time some States may have permits programs that have been approved by EPA under Title V and, therefore, may issue permits for early reductions, instead of EPA issuing the permits. Mr. William Dennison said that one issue that had to be reconciled was that some States, according to State law, may have to issue permits under a certain time frame that may be shorter than that required under Title V permitting. This would lead to the situation where a permit issued under State law may not fully conform to the requirements for a Title V permitting program.

Ms. Deborah Sheiman stated that she felt there were problems with data collected for the Toxics Release Inventory that created difficulty in making year to year comparisons of emission levels, and these types of problems may occur under the early reduction program unless it is designed carefully. Ms. Sheiman expressed concern about allowing a source to take credit for something that happened in the past, such as using a shutdown as a credit which would allow another emission point to avoid having to meet a standard. How the baseline is defined and what reductions are creditable under the program will determine whether the environment actually will benefit from early reductions or the reductions are merely on paper. Mr. Weigold responded that the use of shutdowns in the early reduction program had been discussed at length in the first Roundtable meeting involving various interest groups on January 17, and would be discussed further in the next meeting on February 7. He further stated that there were some situations in which shutdowns would be beneficial to the environment.

Mr. Ralph Hise stated that the potential environmental benefit for early reductions shown in the EPA presentation was only one hypothetical example,

and he could make up another example that would show the opposite effect. Would EPA still proceed with the program if it really is not a winning situation for the environment? Mr. Weigold responded that the early reduction program is a high priority for the EPA and we will be proceeding with implementing the program. He was interested in seeing an example from Mr. Hise of a circumstance where the environment would not benefit from early reductions. Mr. Hise then asked about enforcement against a company that initially achieved 10% of base year emissions but in subsequent years may emit 12%; what would EPA do about these overages? Mr. Weigold, speaking for himself, said he would do nothing about it. However, if someone said they were getting 90% reduction but actually were achieving 20% or 0%, you would want to enforce against that. Mr. Weigold said that we need to use discretion, because the thing that would kill the 1990 amendments is to attempt to go after every exceptional case. Clearly, EPA is concerned with enforcement, but if EPA gets numerous applications, we won't be able to verify every emission estimate on site. EPA is contemplating random audits of baselines and reduction demonstrations to assist in enforcement.

Ms. Vivian McIntire said that generally most people believe early reductions are beneficial, and EPA should provide as much flexibility as possible to encourage use of the program. Ms. McIntire also expressed concern that the States buy into the program to avoid the situation where a source has satisfied EPA requirements but the State requires more. Mr. Beck agreed that a source should be aware of all the requirements it may face before embarking on an early reduction program and needs to know how a State feels about the program. As a final comment, Ms. McIntire said she was reading some EPA information related to the Industrial Toxics Project (ITP) which said that reductions made under the ITP would be creditable under the early reduction program. Mr. Beck said that EPA was sensitive to the differences between the two programs and the fact that in order to obtain credits under the early reduction program certain criteria would have to be met. Future information about the programs sent out by EPA would make sure to emphasize that credits under the ITP project don't necessarily translate to credits under the early reduction program.

Mr. Paul Arbesman commented that from the slide in the EPA presentation on the definition of source it appeared that EPA eventually was going to choose one of the five options to use in the program. He asked if EPA might not allow all the options to be used in the interest of providing flexibility to the source and in recognition that situations will vary from source to source. Mr. Weigold responded that one of the source definition options listed in the EPA overhead actually encompassed all the others. It provides the source maximum flexibility to undertake early reduction projects.

Dr. Patrick Atkins noted that decisions on the options had not been made and wondered how they would be made. Mr. Weigold answered that EPA wants to obtain a lot of support for the early reduction program and, therefore, is proceeding deliberately and trying to give interested parties an opportunity to participate in the design of the program. He said internal briefings had been scheduled with EPA management and that the Office of Management and Budget had been contacted in an effort to move forward with decisionmaking. He explained that although it was an ambitious undertaking to propose regulations for such a complicated and sensitive program by the end of March, EPA was committed to doing so because we need to give enough time to the

sources to make the program work, timing is crucial to the process.

Mr. Arbesman asked if there would be a central location for processing early reduction program documentation, since the States likely would not be writing permits at the outset. Mr. Weigold indicated that the plan would be for the EPA Regional Offices to handle the enforceable commitment paperwork as the program got started. He indicated that the main emphasis in evaluating enforceable commitments would be on the adequacy of the baseline.

Mr. Donald Arkell asked if he was correct that the EPA regulations would include emission estimating methodology. Mr. Beck said that the regulations would specify what information the source needed to supply to obtain a compliance extension, such as exactly what emission data and corresponding support documentation was necessary. Mr. Beck added that EPA would issue documents specific to source categories that would delineate ways to estimate emissions that EPA thought would produce valid results. The first of these documents would cover sources subject to the early section 112(d) standards.

Mr. Charles Collins reinforced a concern raised earlier having to do with coordination with State programs for toxic pollutants. He saw great potential for conflicts to arise. Mr. Weigold indicated that EPA has been talking with STAPPA and ALAPCO about the program and seeking their input. However, there was still a need to sell the program to the States.

Mr. O'Sullivan was in favor of States being able to obtain interim approval of their permitting programs so they could take responsibility for the early reduction program, especially if a State already had in place an enforceable permit program for new source review and an operating permits program. Mr. Weigold expressed the opinion that it may be beneficial to have central management of the program during the startup phase to get through the rough spots, and then bring the States in as early as possible after that.

Ms. Sheiman asked if EPA could elaborate on the high-risk pollutants. Mr. Weigold responded that EPA could not give more details at the present time, and in fact EPA had made no decisions regarding the high-risk pollutants. He said EPA planned to discuss high-risk pollutants at the next roundtable meeting on February 7, and at that time would present EPA's current thinking. Mr. Hise asked when the high-risk pollutant listing would be completed. Mr. Weigold said it would be published as part of the early reduction package.

Following a presentation by Joe Hovious representing the Chemical Manufacturers Association, a few additional questions were asked by the Committee.

Mr. O'Sullivan asked Mr. Hovious to clarify some statements he had made during his presentation on the timing for submittals and responses for a source trying to participate in the early reduction program. Mr. Hovious explained that the relatively short 45 day review turnaround for an enforceable commitment submittal was necessary to give the source enough time to plan emission reductions and to implement control programs. Applications for construction permits and new source review permits would be submitted to the State as soon as possible after control plans were made. Operating permits would be applied for in the 1994 time frame, after operating permit

programs were in place and after source's had been able to make the reductions. Mr. O'Sullivan's last question concerned how Mr. Hovious viewed making the letter of commitment federally enforceable. Mr. Hovious said the way he envisioned the process working was that the enforceable commitment would be a letter of intent to make the reductions and that if the source did not achieve the required reductions, it would have to meet any applicable standards with no compliance extensions.

Mr. Dennison also asked for clarification of the procedures involving enforceable commitments. Mr. Weigold said that what was needed was a prompt response from EPA on any enforceable commitment submitted. He said further that EPA would want to review commitments to see that the source had a reasonable baseline and had a control program planned, but that EPA could not do an exhaustive review of each one. It was not anticipated that enforceable commitments would go through a public review process, which would later be required under the permit application process.

Mr. Arbesman commented that with regard to enforceability, a source would have to secure State permits to make process changes or change control equipment. He said he would consider those State permits enforceable commitments. Therefore, there may be some need to broaden the scope of what's enforceable under the overall program to keep the process moving, since the sources already will have to have approved paperwork at the State level to make voluntary reductions.

STATEMENT OF
JOE HOVIOUS
ON BEHALF OF
THE CHEMICAL MANUFACTURERS ASSOCIATION
BEFORE THE
NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE
ON THE HAZARDOUS ORGANIC
NATIONAL EMISSION STANDARDS
FOR HAZARDOUS AIR POLLUTANTS

JANUARY 30, 1991

CHEMICAL MANUFACTURERS ASSOCIATION
TESTIMONY BEFORE THE NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE ON
EPA'S CREDIT FOR EARLY REDUCTION PROGRAM FOR
HAZARDOUS AIR POLLUTANTS

My name is Joe Hovious. I am the Assistant Director of Environmental Affairs for the Chemicals Division at Union Carbide Chemicals and Plastics Company, Inc. At Union Carbide, I have the responsibility for Air Issues. Today, I am speaking on behalf of the Chemical Manufacturers Association (CMA) where I serve as the leader of the Ad Hoc Work Group on the Credit for Early Reductions Program. CMA is a non-profit trade association whose member companies represent over 90% of the production capacity of basic industrial chemicals in the United States. I am very pleased to present the CMA views to the National Air Pollution Control Techniques Advisory Committee.

CMA was very active in the legislative developments shaping the Clean Air Act Amendments of 1990. CMA companies believe that the Credit for Early Reduction Program is a flexible and useful program that can provide significant reductions in emissions prior to the implementation of the Maximum Achievable Control Technology (MACT), thereby resulting in cleaner air for the nation, sooner than mandated, while also allowing industry the flexibility to reduce emissions in an economically sound manner. Certain CMA member companies have already participated in voluntary reductions with great success, or have voluntary reductions projects in the planning process.

We suggest that the main objective of the program be to optimize the early reduction of Hazardous Air Pollutants (HAPs) by creating a simple and flexible program that maximizes incentives and minimizes disincentives to participate. The Early Reduction Program will then result in significant HAP emission reductions well ahead of the MACT schedule.

The schedule for the Early Reduction Program necessitates that sources which fall under the first MACT group make enforceable commitments and plan for reductions prior to the date of proposal of the first MACT standard. This will require almost immediate action and will compel significant funding commitments from companies during the next six months. It is crucial that the program be defined quickly and include enough incentive and flexibility to receive the endorsement of management. Companies will also want the commitment to be acceptable to the state/local agencies who will subsequently be responsible for the development and implementation of the permits program. Some specific examples of elements of a simple and flexible program follow.

We believe that the definition of "source," for the purpose of the Early Reduction Program, should be flexible and allow a company to group emissions points to achieve the early reductions. The grouped emissions may include: an entire facility, a type of emissions within a source or process unit, a manufacturing unit, or an emission point such as a stack. The group could be defined for either a particular HAP or HAPs in general. A MACT extension would apply from the time MACT becomes applicable for each of the particular points in the group. The key to the grouping of emissions points is for the source to be able to use the best mix of controls and combinations within a facility to achieve effective reductions. If this is not allowed, sources will likely lose incentive to participate in the program.

The shut down of sections within a facility is a true emissions reduction and should be allowable under the Early Reduction Program in the Clean Air Act. The goal of the program is the early reduction of HAPs emissions into the ambient air. Elimination of emissions should count whether it is achieved as a result of a halt in manufacturing or the addition of controls as long as the 90% reductions are achieved for the designated grouping.

The form and content of the enforceable commitment is also of importance. CMA suggests that sources submit a letter of commitment to EPA regional offices that would include information on the source, the group of emission points included in the commitment, the baseline emissions and estimating basis, and a conceptual plan for achieving the 90% reduction. The combination of the letter of intent and operating permits obtained after reductions are achieved would be considered to be the "enforceable commitment" noted in the Clean Air Act. The EPA would need to respond to the letter of intent within 45 days. The completed reductions achieved by the company would be the basis for the operating permits program under Title V of the Clean Air Act Amendments.

The acknowledgement (within 45 days) of the early reduction commitments by state/local agencies, is vital to the success of the program. As state/local agencies are responsible for issuing construction or operating permits, the acknowledgement of the early reduction commitment is needed to insure that the 90% reductions are acceptable. The state/local agencies will either issue or comment on the final operating permits under Title V.

The baseline used to measure the 90% reduction should be based on the best available data. In most cases, the SARA 313 emissions estimates, or equivalent calculation procedures, should be used for the baseline. In the letter of commitment, the source would indicate the justification for the baseline defining the various grouped emissions points. Annual emission rates would be used.

With the exception of the specific chlorinated dioxins and furans identified in section 112(i)(5)(E), all materials on the HAPs listing should be combined as requested by the source to calculate the 90% reductions. Other combinations of listed materials will be too complicated to implement in this program.

Several other voluntary reduction programs are being implemented by EPA including the Industrial Toxics Program (ITP) and the various state Air Toxics Programs. It is important that these programs are coordinated so that duplication does not occur. For example, participation in the EPA ITP should be easily transferable into credit for early reduction.

If a source does not meet the 90% Early Reduction Program deadlines, then it would have to comply with the MACT standards. Sources will not be inclined to voluntarily seek early reductions if the enforceable commitment requires sanctions. The important issue is the reduction of emissions to improve air quality. The more flexibility and simplicity that is built into the program, the greater the number of companies that will likely participate and achieve the early emissions reductions. If sanctions are included, companies will be less willing to make commitments to the Early Reduction Program.

That concludes my comments. I would be happy to answer any questions at this time.

STATUS OF DRY CLEANING NESHAP PROJECT

Presentation for the
NAPCTAC Committee

January 30, 1991

BRIEFING OUTLINE

1. History

2. Industry Description

3. Emissions

4. Controls, Costs

5. Regulatory Analysis

6. Schedule

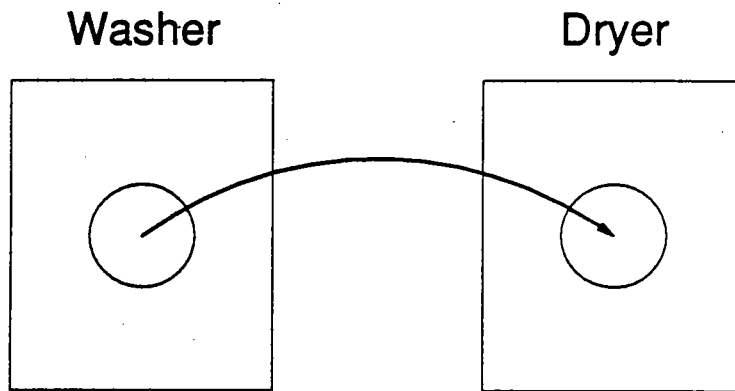
HISTORY OF STANDARDS DEVELOPMENT

- A. NSPS proposed in 1980**
- B. NESHAP development initiated in 1986**
- C. OSHA PEL reduced from 100 ppm to 25 ppm in 1989**
- D. PERC and 1,1,1-TCA on hazardous pollutant list - 1990**
- E. Consent decree entered in Frances P. Cook, et al versus EPA in March 1990**
 - Requires proposal 1 year after Act passage, promulgation 2 years after**

DESCRIPTION OF INDUSTRY

TYPES OF MACHINES

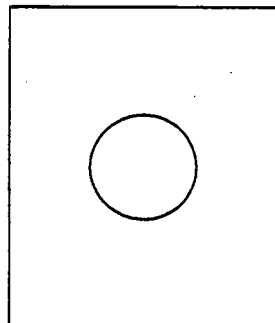
TRANSFER



- Older technology
- No demand for new machines

DRY-TO-DRY

Wash & Dry



- Newer technology
- Accounts for all new machine sales
- Lower fugitive emissions
- More easily meets OSHA regulations

TYPES OF BUSINESSES AND MACHINE SIZES

<u>Sector</u>	<u>Capacity (lb of clothes)</u>
----------------------	--

Industrial	140-250
-------------------	----------------

Commercial	15-100
-------------------	---------------

Coin Operated (self-service, plant-operated)	8-12
---	-------------

DRY CLEANING ESTABLISHMENTS BY SECTOR

Sector	Estimated Transfer	Estimated Dry-to-Dry
Commercial	7,250	19,200
Industrial	100	40
Coin-Operated		
Self-Service	0	200
Plant Operated	0	2,600
Totals	7,350	22,040

EMISSION SOURCES

- **Vents**
 - **Dryer**
 - **Washer (transfer only)**

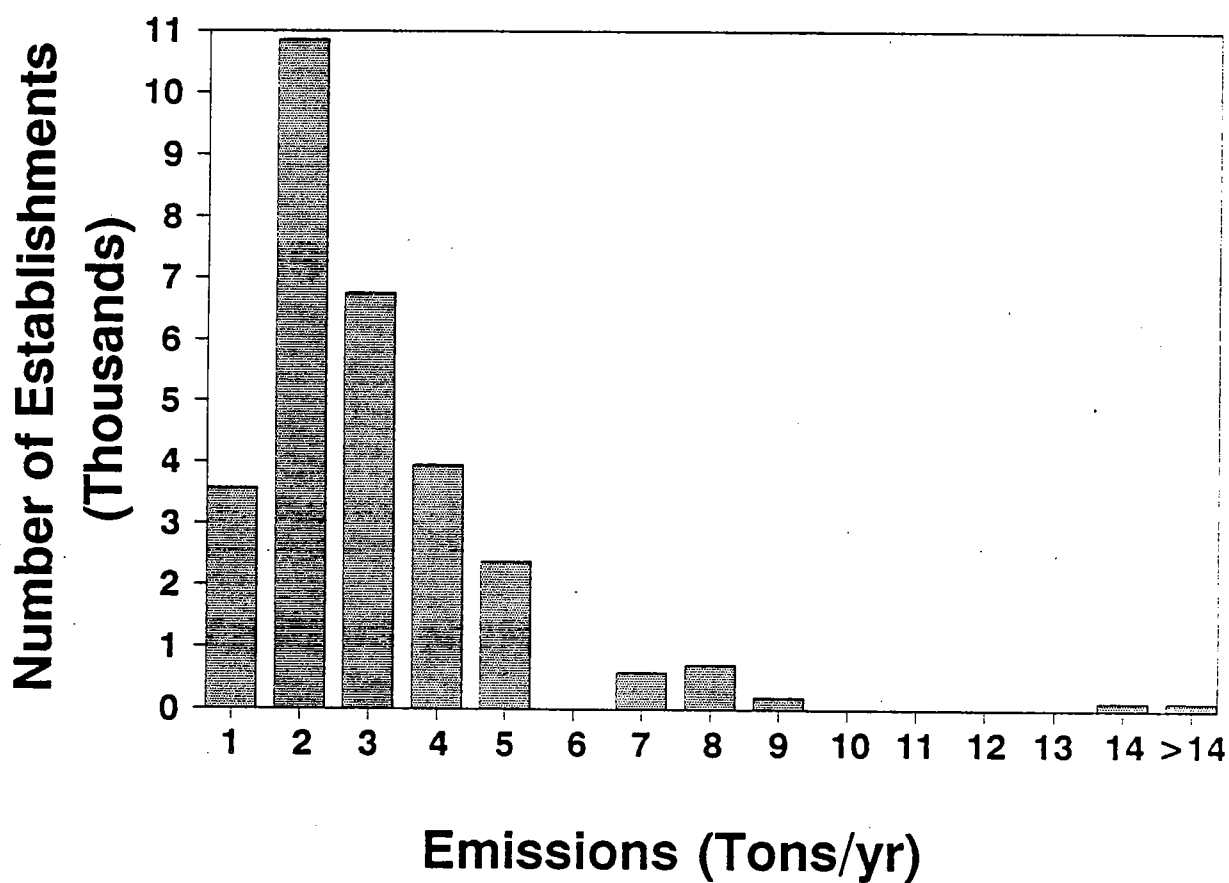
- **Fugitives**
 - **Leaks**
 - **Storage**
 - **Clothing transfer (transfer only)**

EMISSION FACTORS (lb HAP/100 lb clothes cleaned)

	Dry-to-Dry	Transfer
<i>Uncontrolled</i>		
Vent	3.1	4
Fugitive	<u>2.5</u>	<u>5</u>
Total	5.6	9

About 2.5 lb HAP/100 lb clothes cleaned
goes to solid waste

EMISSIONS VS NUMBER OF ESTABLISHMENTS



	Number	Emissions (Tons/yr)
Major Sources	300	7,400
Area Sources	29,000	86,200

POLLUTION PREVENTION CONTROLS

VENTS (45-55% of emissions)

EFFECTIVENESS

- | | |
|--------------------------|--------------------------------|
| • Carbon Adsorber | 95% |
| • Refrigerated Condenser | 95% Dry-to-Dry
85% Transfer |

FUGITIVES (45-55% of emissions)

- | | |
|---|----------------|
| • Good Housekeeping <ul style="list-style-type: none">- proper operating practices- leak detection and repair | Not quantified |
| • Use Dry-to-Dry instead of transfer | Up to 50% |

OTHER

- Solvent Substitutes
- New German Machine

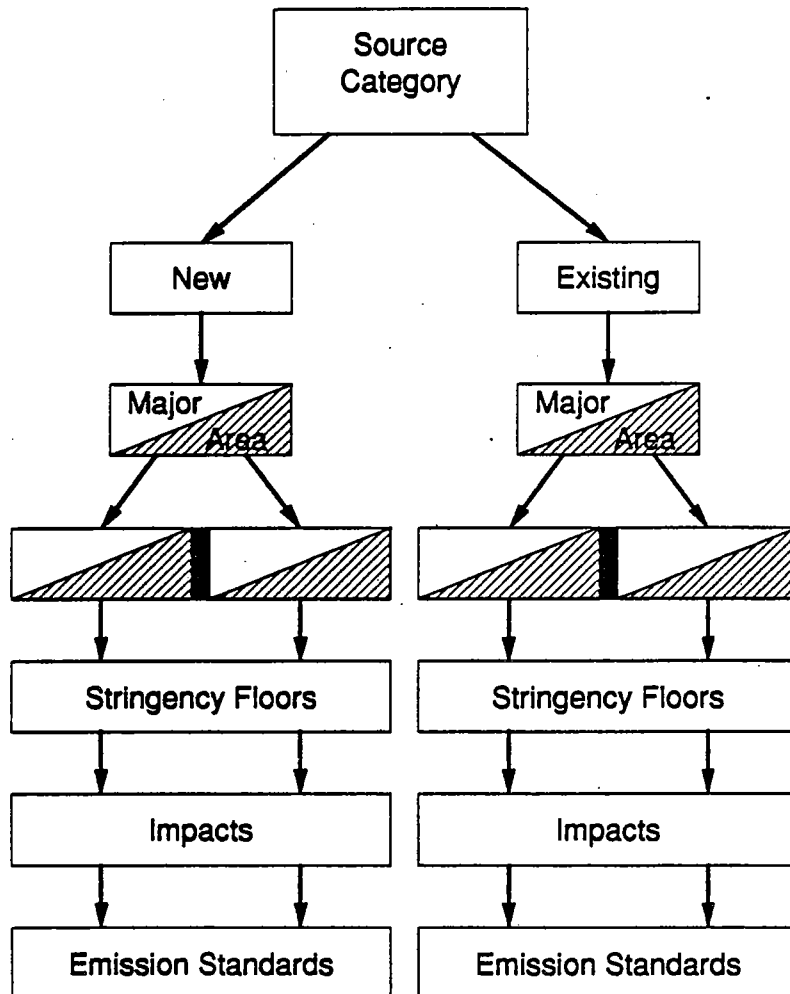
COST OF VENT CONTROLS

Sector	Capital Cost (\$)	Total Annualized Cost (\$)	Average Cost Effectiveness (\$/Mg HAP)
Industrial			
Transfer	10,000	4,800	Savings
Dry-to-Dry	10,000	4,800	Savings
Commercial			
Transfer	7,000 to 10,800	3,900	60 to 700
Dry-to-Dry	6,300 to 8,700	1,700 to 3,800	0 to 2,700
Coin-Op			
Dry-to-Dry	3,500 to 8,600	3,800 to 7,700	18,800 to 38,500

REGULATORY ANALYSIS

EMISSIONS STANDARDS UNDER AMENDED SECTION 112 (MACT)

INPUTS



Emissions
($>$ or $<$ 10T/yr)

Distinguish Classes,
Types and Sizes
(Similar Source Groups)

New: Best Controlled
Existing: Best Existing 12%

Costs, Nonair Health,
Environmental, Energy

or for Area Source

Set Standards based on
"Generally Available Control
Technology" GACT

MAJOR SOURCE ANALYSIS

SIMILAR SOURCES

- For Major Sources, Only Significant Factor For Determining Similarity Is Type Of Machine

STRINGENCY FLOOR

Similar Source	New Source Floor (Best)	Existing Source Floor (Best Existing 12%)
<hr/>		
Dry-to-Dry Machines		
Vents	95%	95% (1/2 of Sources)
Transfer Machines		
Vents	95%	95% (1/3 to 1/2 of Sources)
<hr/>		

MAJOR SOURCES NATIONAL IMPACTS OF REGULATORY OPTIONS FOR VENTS

Regulatory Option	Number of Affected Machines	Emission Reduction (Mg HAP/year)	Average Cost Effectiveness Over Baseline (\$/Mg HAP)	Cost Impact (%)
Major Sources				
Uncontrolled Dry-to-Dry Machines				
95% Vent Control	18	277	Savings	0
Uncontrolled Transfer Machines				
95% Vent Control	217	1958	Savings	0
TOTAL	235	2235	Savings	

AREA SOURCES ANALYSIS

SIMILAR SOURCES

- Significant Factors Are:
 - Type of Machine
 - Type of Business
 - Machine Size/Solvent Consumption Level

STRINGENCY FLOORS

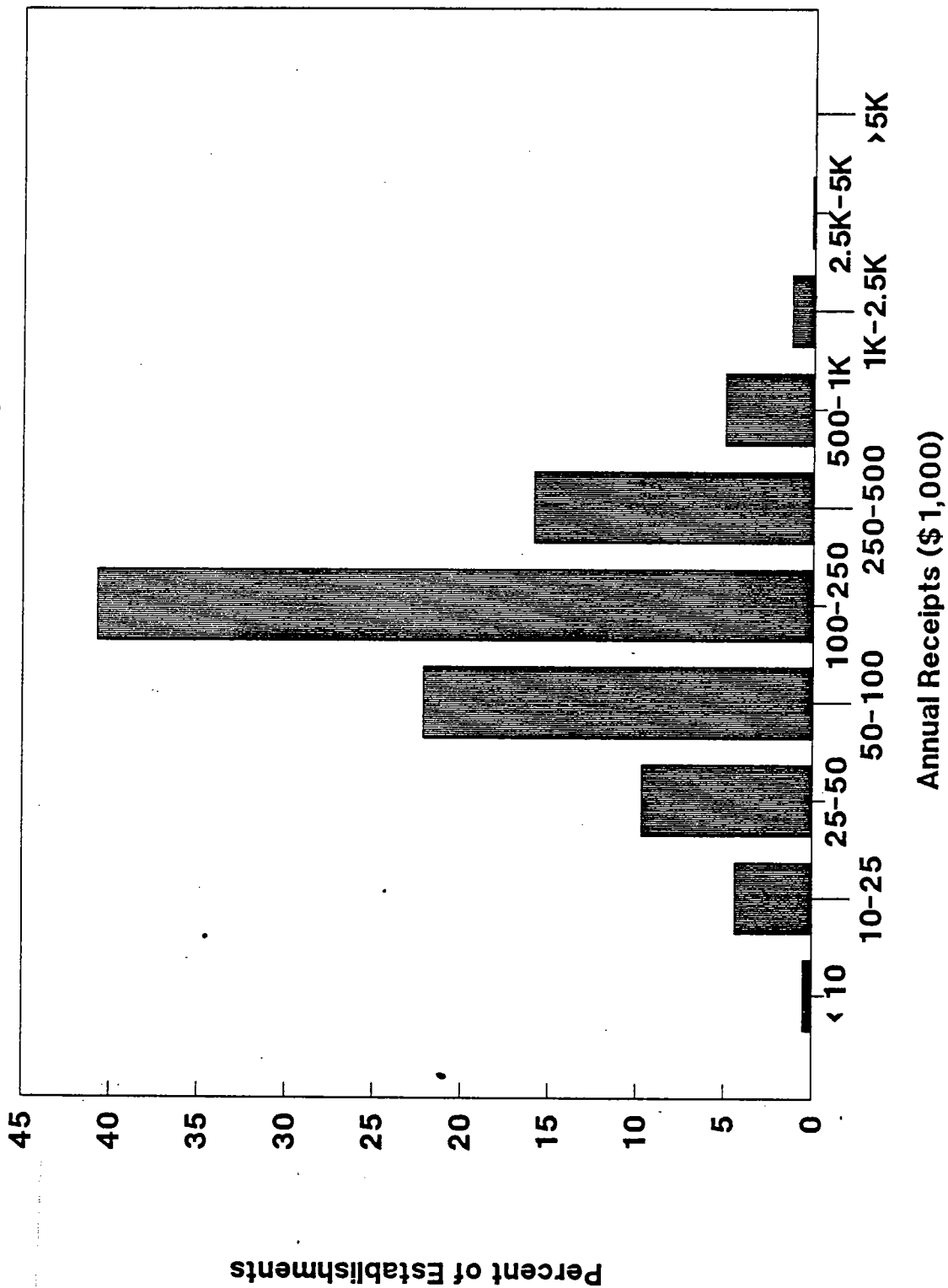
Similar Source	New Source Floor (Best)	Existing Source Floor (Best Existing 12%)
Commercial		
Dry-to-Dry	95%	95% (over 60% of sources)
Transfer Vents	95%	85%-95% (over 60% of sources)
Coin-Operated		
Plant Operated Dry-to-Dry	95%	95% (1/2 of sources)
Self Service	95%	No Control (5% have 95% control)

AREA SOURCES NATIONAL IMPACTS OF REGULATORY OPTIONS FOR VENTS

Regulatory Option	Number of Affected Machines	Emission Reduction (Mg HAP/year)	Average Cost Effectiveness Over Baseline (\$/Mg HAP)
Area Sources			
Uncontrolled Dry-to-Dry Machines			
95% Vent Control	11,030	12,560	3,580
Uncontrolled Transfer Machines			
85% Vent Control	2,660	4,830	560
TOTAL	13,700	17,400	2,450

Income Distribution - Commercial Plants

Based on 1987 Census Data



EFFECTS ON LOW INCOME DRY CLEANERS

Consumption Ranges as Represented by Annual Receipts	Average Cost Effectiveness Over Baseline at Midpoint (\$/Mg HAP)
<\$25,000/yr	27,200 (commercial) 35,000 (coin-operated)
\$25,000/yr-\$50,000/yr	8,900 (commercial) 21,400 (coin-operated)
\$50,000/yr-\$75,000/yr	5,200
\$75,000/yr-\$100,000/yr	3,600
>\$100,000	500

COMPLIANCE TIMES

Factors

- Clean Air Amendments Allow Up to 3 Years for Existing Sources to Comply
- Limited Number of Vendors (8)
- Thousands of Control Devices Needed
- Controls are Generally Off-the-Shelf Items
- Vendor Capacity Reportedly Sufficient to Supply Needs in 1 Year

Current Staff Thinking

New Sources - Upon Startup

Existing - 18 months

SCHEDULE

Proposal

11/91

Promulgation

11/92

DISCUSSION

Following the EPA presentation, Mr. Jim Weigold, EPA/ESD, opened the floor to questions and comments from the NAPCTAC members. Both EPA staff members and contractor personnel were available to discuss each issue of concern. Industry representatives then made presentations, which were also followed by a discussion period. The questions and comments posed during the discussions are summarized below.

Mr. Donald Arkell, a committee member, asked about the ability of a carbon adsorber to function properly, and inquired as to the fate of the vapors when the carbon canisters are reactivated. Mr. Dave Beck, EPA/CPB, responded that there were no canister type carbon adsorbers used in the dry cleaning source category, and all carbon adsorbers used in the technical analysis were of the regenerative type. Mr. Beck explained that the carbon bed containing perchloroethylene (PCE) is desorbed with steam. The recovered PCE is then transported to the condenser where it comes in contact with water. Because PCE is not very soluble in water, it is decanted off and returned to the process.

Mr. Arkell then inquired about the extent of PCE losses during this process. Mr. Beck responded that no PCE is lost during the steam cycle; however, when decanted, some very small amounts of PCE are lost due to evaporation, probably less than 2 lbs/year.

Mr. Arkell also asked whether the vendors who supply the control equipment would service the carbon adsorber systems. Mr. Beck responded that there are two known vendors of carbon adsorber equipment, and that they would service the carbon adsorber systems.

Dr. John Pinkerton, committee member, inquired whether there are State regulations that cover the dry cleaning industry. Mr. Beck responded that a Control Techniques Guideline (CTG)

document was published for PCE in the late 1970's. He pointed out that some States have adopted it. Dr. Pinkerton also asked what level of control States are currently using. Mr. Beck stated that the level of control was generally about the same as the level discussed in the presentation.

Dr. Pinkerton also inquired how cost effectiveness would influence selection of the standard, given that different pollutants have different toxicity characteristics. Mr. Weigold responded that cost effectiveness would be a factor in setting standards, but that it would depend upon the nature of the pollutant. He remarked that there is no threshold cost-effectiveness level. Instead, the cost effectiveness for each pollutant would have to be considered on a case-by-case basis.

Dr. Pinkerton raised a question regarding the facility in California that is reported to own one of the new German (BOWE or Permac) machines. He questioned that if the facility in California achieves greater than 95 percent control, would this level of control be considered "best of the best." Mr. Beck stated that an evaluation of this technology would require testing and analysis by the EPA; and if current efforts were delayed long enough to perform this testing and analysis before setting the regulation, then the court-ordered deadline (November 15, 1991) would not be met. Further, he pointed out that the BOWE machine is at least twice as expensive as a new dry-to-dry machine and, therefore, the amount of emission reduction achieved per cost increase would be small. He added that because of the high cost, area sources in this category are not likely to choose this technology even if it were demonstrated.

Dr. Pinkerton also asked about the amount of solid or liquid wastes generated from the carbon adsorbers or refrigerated condensers. Mr. Beck responded that solid wastes were generated by carbon adsorbers, and the carbon bed would eventually have to be replaced. Dr. Pinkerton asked whether this waste would be considered a hazardous waste under the Resource Conservation and

Recovery Act (RCRA) and, if so, were those costs considered in the analysis. Mr. Beck responded yes to both inquiries.

Dr. Pinkerton questioned that if all of the sources that were presented were regulated, would all of them be required to obtain a permit under Title V. Mr. Weigold responded that requiring a permit for each source would translate into a large number of permits. He explained that the EPA is considering reducing this large number by deferring or exempting small sources from permit requirements and/or by having a general permit.

Dr. Pinkerton also asked whether individual States would be responsible for determining compliance. Mr. Weigold responded that States are responsible for determining compliance for all permitted sources but, due to the large number of sources, this does not necessarily happen.

Ms. Vivian McIntire, a committee member, asked whether all of the carbon adsorption systems are regenerative types, or if there were any canister types evaluated in the analysis.

Mr. Beck responded that they are all regenerative.

Ms. McIntire also inquired whether businesses are capable of operating carbon adsorbers in a technically accurate manner. Mr. Beck responded that some problems have been found with the accuracy of operations. Mr. Beck stated that the incentives to operate a carbon adsorber properly are not as great as those for a refrigerated condenser. If a dry cleaning machine is using a carbon adsorber improperly (i.e., not desorbing the carbon bed), the carbon bed can become totally saturated (and therefore unable to remove additional PCE from the vented vapors). Because the excessive emissions would be vented outside, the machine would still be able to clean clothes without any disruption or noticeable difference in operation. However, if a refrigerated condenser started to fail (i.e., if it were not cooling to a certain temperature), this failure would be noticed because a greater amount of residual PCE would be found in the clothes (causing customer dissatisfaction) and a higher worker exposure

would be measured. The owner/operator would need to repair the refrigerated condenser to continue in business.

Mr. William O'Sullivan, committee member, had three comments. First, he suggested implementing a machine certification program, which would require vendors to provide written operating instructions and to conduct training programs for the control devices they sell. He remarked that because there are over 1,000 dry cleaners in New Jersey with owners/operators who speak a variety of languages, his State requires control device instructions to be printed in several languages.

Second, Mr. O'Sullivan inquired about the material balance calculations and the total amount of PCE used. He asked whether the calculations included all the sources of PCE, including residual PCE in clothes. Mr. Beck responded that industry was conducting a study to help determine the amount of PCE left in clothes and the amount of off-gassing. He stated that Mr. Bill Fisher, of the International Fabricare Institute (IFI), would speak on this topic later.

Third, Mr. O'Sullivan recommended that facilities be required to keep records of the total amount of PCE used and the clothes processed. He added that the residual risk assessment for the dry cleaning source category is high because most dry cleaners are located near population centers, and their exhaust stacks are short.

Ms. Deborah Sheiman, committee member, agreed with Mr. O'Sullivan concerning the importance of regulating dry cleaners because of their proximity to population centers.

Ms. Sheiman also expressed some general concerns about the legal interpretation of the definition of "stringency floor" given in the new Clean Air Act Amendments (CAA) of 1990. She questioned how the floor is defined for the dry cleaning source category and also what the relationship of the floor is to the actual standards being set. She recalled that for the existing sources in the self-serve coin-operated category, Mr. Beck had stated that the 12 percent stringency floor would be "no floor."

She disagreed with this interpretation and argued that the CAA amendments read that the floor should be the average of the top 12 percent so that if 5 percent have 95 percent control and 7 percent have no control, the average of the top 12 percent would require the floor to be set at about 40 percent.

Mr. Weigold replied that in determining the stringency floor, the level of control for available options must be considered. He pointed out that it is not feasible to require a control device to be designed to meet a 40 percent vent control level. He stated that the existing options for the coin-operated sector are 95 percent control or no control. This means that if greater than 88 percent of the category have no control, then no control would be considered as the floor. He stated that the only two options in this case would be a floor at 95 percent control, or no control.

Ms. Sheiman responded that based on legislative history, a 12 percent floor is a minimum. She pointed out that the standard could be more stringent than that level, but not less stringent. Mr. Beck agreed and stated that he did mention that in his presentation. Mr. Weigold said that the point is well taken, and will be discussed further during EPA's internal review process.

Mr. William Dennison, a committee member, commented that in California, where there are large population centers, a cooperative program is underway between the control industry and the dry cleaners. He stated that the dry cleaners are very small sources, so that an operator's certificate is necessary to achieve effective control. He also mentioned that maintenance would need to be performed on control devices, especially when dealing with these smaller facilities. He believed that even if instructions are included, they may not be followed. This problem is compounded by the lack of sufficient numbers of enforcement people to ensure that compliance is being met. He suggested that, for those owners/operators who are not trained to handle chemical processes, a service contract for the control devices needs to be required with the sale.

Mr. Ralph Hise, a committee member, had questions about some of the numbers given in the EPA presentation. Specifically, he wanted to know the relationship between the numbers for total emissions and emission reductions. Mr. Beck pointed out that the numbers in question represent actual emission reduction and not the residual emission level. He further explained that up to one half of the emissions are from vents and these are the emissions reduced by installing control devices. The other half of the emissions are attributed to fugitives. Mr. Hise then noted that, in actuality, the regulation would achieve a very small overall emission reduction. Mr. Beck concurred, adding that overall, the dry cleaning industry is already well controlled because close to three-fourths of the industry have control devices, and the number of facilities with controls is increasing. Mr. Weigold noted that the regulation would also require controls to reduce fugitives.

Mr. Hise mentioned that in the table in the EPA presentation concerning the effects of the standard on low income dry cleaners, it would be helpful to add a column with emission reduction for each segment. Mr. Beck agreed that the additional column might be helpful, but he noted that the two smallest categories would have very small numbers, in the range of 100 Mg/year or less.

Dr. Patrick Atkins, committee member, asked about the origin of the 2.5 lbs/year of PCE attributed to solid waste. Mr. Beck explained that the used PCE contains those substances removed from the clothing during the washing process. This "dirty" PCE is then filtered and distilled. The waste created in this filtering process is the residue sludge that requires disposal.

Dr. Atkins inquired whether this filtering system is separate from the vapor recovery unit and, if so, would it also be regulated. Mr. Beck responded that the fugitive emissions from the filtering system will be regulated by good housekeeping practices but noted that, in general, these emissions are small.

The final comment on Mr. Beck's presentation came from Ms. Sheiman. Ms. Sheiman recalled that Mr. Beck had mentioned

that a certain percentage of the industry use nonhalogenated solvents. She asked if Mr. Beck knew what this percentage was. Mr. Beck responded that from 15 to 17 percent of machines use petroleum solvents. He was not sure as to the exact chemical content of the petroleum solvent mixtures, but felt that the amount of HAPs in petroleum solvents would be small. He noted, however, that the exact constituents may need to be investigated. He reiterated that this regulation is specific to PCE and 1,1,1-trichloroethane.

Mr. Tom Cortina, of the Halogenated Solvents Industry Alliance (HSIA), was ill and not able to attend the NAPCTAC meeting; however, he sent a letter with his remarks that Mr. Weigold read aloud. There were no comments or questions following his statement.

Mr. Bill Fisher, of the International Fabricare Institute (IFI), preceded his talk with some general comments and responses to some of the questions posed to Mr. Beck. He stated that a consistent definition of generally available control technology (GACT) is found in the CAA Conference report, and both the House and Senate reports. He stated that in the House and Senate reports, dry cleaning was given as a specific example of GACT.

He remarked that dry cleaning is the oldest industry user of carbon adsorbers. Carbon adsorbers have been used by the dry cleaning industry for 30 to 35 years, so they have become standardized in their use. In response to the question about whether owners and operators of dry cleaners are capable of operating carbon adsorbers, Mr. Fisher responded that they are. He explained that, furthermore, before the proposed New Source Performance Standard (NSPS) for dry cleaners died, very clear and explicit instructions were given in that regulation for operating carbon adsorbers properly. He noted that he would support including these same requirements in the current regulation, except he would add one change--the frequency of desorption should be half of the given value, meaning that carbon adsorbers should be desorbed twice as often as the frequency stated in the NSPS.

Concerning petroleum dry cleaners, Mr. Fisher reported that current regulations exist in the form of a CTG (8 or 9 years old) and an NSPS (6 to 7 years old). He noted that these regulations are still applicable today.

Regarding the degree of control already in place at the State level, Mr. Fisher stated that over half of the States have dry cleaning regulations. He said that many of the States simply incorporated the proposed NSPS regulations into their own. He added that 65 to 75 percent of the industry is already controlled.

Mr. Fisher estimated the amount of PCE contained in separator water to be on the order of 6 ounces per year for a dry cleaning machine without a carbon adsorber, that generates about 50 gallons of separator water per year. He estimated the total amount of residual PCE found in cleaned items to be on the order of 2 lbs for an establishment cleaning 70,000 lbs of clothing per year. He stated that the amount of PCE emitted from individual garments to be on the parts per billion level.

Mr. Fisher described the Permac machine as "MACT Plus" because it has a carbon adsorber "piggy-backed" onto a dry-to-dry machine containing a refrigerated condenser. He stated that a 40 to 50 lb machine with a refrigerated condenser added onto a carbon adsorber would recover just under 9 extra gallons of PCE per year. He stated that the installed cost of a conventional dry cleaning machine is from \$30,000 to \$50,000 and that the base price of a Permac machine starts at \$65,000. He remarked that this cost effectiveness of recovery would be quite high.

After completing these remarks, Mr. Fisher gave his prepared presentation. Following his presentation, the floor was once again opened for questions and comments.

Ms. McIntire inquired whether the members of Mr. Fisher's trade organization included owners of coin-operated machines. Mr. Fisher responded that IFI's membership did not include coin-operated establishments. He mentioned that Mr. William Sietz, of the Neighborhood Launderer's Association, represented coin launderers and, together, the two trade

associations had a combined membership of 12,000 to 15,000. Ms. McIntire also asked if he were comfortable with the controls proposed. Mr. Fisher responded that he was comfortable with the proposed controls.

Mr. O'Sullivan inquired whether Mr. Fisher thought controls were needed for coin-operated machines. Mr. Fisher responded that because he did not represent coin-operated machine owners, he would not speak for them. He noted, however, that the numbers of coin-operated machines have been declining, and he estimated (based on 1987 data) that no more than 11 percent of all machines are coin machines. He added that he thought the numbers in the EPA presentation concerning the population of coin-operated machines were high. Because these numbers are from the industry, he attributed the inflated numbers to a lack of current surveys conducted by the coin-operated sector.

Dr. Pinkerton asked whether Mr. Fisher thought the early reduction program had any relevance to dry cleaners. Mr. Fisher responded that he did not think it did.

Dr. Atkins remarked that he missed whether Mr. Fisher had suggested a breakpoint for machine sizes to be exempted from the regulation. Mr. Fisher said that he did not indicate a specific level. Rather, he stated that the breakpoint would be associated with profit levels and operating cost ratios, especially for existing machines undergoing modifications. For new machines, however, he would support a MACT level of control.

Mr. Charles Collins, of the Wyoming Department of Air Quality, asked whether affordability would be a criterion for establishing MACT. Mr. Fisher responded that that determination would require guidance from Congress.

Thomas Cortina
Director of Administration
Halogenated Solvents Industry Alliance

HSIA COMMENTS TO NAPCTAC
EMISSION CONTROL STANDARD FOR DRY CLEANING

OUTLINE

- o Dry cleaning is a well maintained industry that has responded to the need for the control of solvent emissions.
- o HSIA has long supported a technology-based approach for the regulation of dry cleaning and other sources of chlorinated solvents.
- o All, but a few, dry cleaning facilities fall below the statutory definition for a major source under Title III of the Clean Air Act Amendments of 1990.
- o Therefore, OAQPS should promulgate an emission standard for the dry cleaning industry utilizing its new authority to specify generally available control technology (GACT) for area source categories.
- o Transfer equipment continues to comprise a significant percentage of the dry cleaning machines currently in operation.
- o The 25-ppm workplace standard provides a considerable incentive for the replacement of transfer machines.
- o OAQPS staff have developed a reasonable assessment of the potential for available technology to control emissions from dry cleaning equipment.
- o The first three regulatory options presented by OAQPS (vent controls, fugitive controls, and equipment replacement) provide a reasonable framework for the development of an emission standard.
- o HSIA agrees with OAQPS staff that the fourth option (solvent substitution) does not represent a viable regulatory alternative.
- o HSIA supports the inclusion of work practice requirements in the emission standard as a cost-effective approach to addressing fugitive emissions.



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STATEMENT OF THE
HALOGENATED SOLVENTS INDUSTRY ALLIANCE
CONCERNING THE
NATIONAL EMISSION STANDARD FOR DRY CLEANING
WITH PERCHLOROETHYLENE AND 1,1,1-TRICHLOROETHANE

BEFORE THE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES
ADVISORY COMMITTEE

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January 30, 1991

STATEMENT OF THE
HALOGENATED SOLVENTS INDUSTRY ALLIANCE
CONCERNING THE
NATIONAL EMISSION STANDARD FOR DRY CLEANING
WITH PERCHLOROETHYLENE AND 1,1,1-TRICHLOROETHANE

Introduction

The Halogenated Solvents Industry Alliance (HSIA) appreciates the opportunity to comment on the development of a national emission standard for dry cleaning with perchloroethylene and 1,1,1-trichloroethane (methyl chloroform). HSIA is an association of users, distributors, producers, and commercial recyclers of chlorinated solvents, including these two substances. Because very little 1,1,1-trichloroethane is used in the dry cleaning industry, and because the machines in which it is used likely will comply with the new emission control requirements, we will focus our comments on perchloroethylene.

In its numerous discussions with the staff of the Emission Standards Division (ESD) over the past few years, and in previous presentations to this Committee, HSIA has supported a technology-based approach to the regulation of chlorinated solvent emissions from dry cleaning and other sources.

As a result of regulatory and economic factors, the dry cleaning industry has been relatively quick to adopt emission reduction and waste minimization equipment and methods. Representatives of the dry cleaning industry can provide a more complete historical perspective, however, and can better address the more technical aspects of the information package developed by ESD staff. HSIA will limit its comments to some of the policy issues raised by the ESD package.

Application of Generally Available Control Technology

Based on EPA and industry estimates of actual emissions, practically all dry cleaning facilities fall below the statutory threshold for a major source under the hazardous air pollutant provisions (Title III) of the Clean Air Act Amendments of 1990 (P.L. 101-549). Consequently, HSIA believes that ESD should develop an emission control standard for the dry cleaning industry utilizing its new authority to specify generally available control technology (GACT) for area source categories.

In fact, the Senate Environment and Public Works Committee offered neighborhood dry cleaners as an example of an industry that could appropriately be subject to a GACT standard. The Senate Committee further defined GACT as an equipment and operational standard that "would require neighborhood dry

cleaning establishments to employ the commercially available systems associated with the lowest measured emissions" (Committee Report 101-228, page 172).

We believe therefore that this approach is consistent with Congressional intent and can achieve an acceptable sufficient level of control while streamlining the regulatory process.

Assessment of Control Options

HSIA believes that the assessment of control options presented to the Committee by ESD staff represents a reasonable framework for the development of an emission control standard for dry cleaning. We further believe that the first three options (vent controls, fugitive controls, and equipment replacement) should form the basis of the staff deliberations. We agree with ESD staff that the fourth option (solvent substitution) does not represent a viable regulatory alternative, nor do we believe does equipment replacement in all cases.

In addition to requiring technology to control process emissions, HSIA supports the inclusion of work practice requirements in the emission control standard to address fugitive emissions.

Transfer Equipment

The principal unresolved issue in ESD's discussion of control options is the treatment of existing transfer equipment. Although this older technology gradually is being replaced with newer (dry-to-dry) equipment, transfer machines still comprise a significant percentage of the machines in operation.

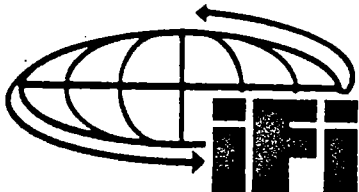
As a result of the new, lower workplace limit for perchloroethylene, however, owners of transfer machines will have a considerable incentive to replace these machines with new equipment. After December 1992, Occupational Safety and Health Administration regulations require that dry cleaners achieve the limit with engineering controls. Because of this expected acceleration of equipment turnover in the industry, HSIA does not believe it is necessary for ESD to impose a requirement for the replacement of transfer equipment according to a rigid schedule.

Exempt VOC Status for Perchloroethylene

Dry cleaning establishments in many parts of the country are subject to volatile organic compound (VOC) control requirements under state implementation plans (SIPs) for achieving the national ambient air quality standard for ozone. These controls are based on the reasonably available control technology established by EPA's control techniques guidelines (CTG) for dry cleaning.

In October 1983 EPA proposed that perchloroethylene be added to the list of organic compounds that have negligible photochemical reactivity and, therefore, may be exempt from SIP regulation. The proposal was based on smog chamber testing conducted by the Agency that established that perchloroethylene contributes less to ambient ozone than some substances already included on the list of negligibly reactive compounds. Subsequently, EPA continued to consider adding perchloroethylene to the list of negligibly reactive compounds, but has not yet done so, in part because controls required under the SIPs were largely in place.

In light of the imminent development of emissions control requirements for perchloroethylene dry cleaning under Title III, we urge EPA at this time to give serious consideration to making a final determination that perchloroethylene is negligibly reactive. The scientific data fully support such action. Moreover, exempting perchloroethylene will not result in a lower level of control, but could eliminate the need for review of the CTG and SIPs for consistency with the ozone nonattainment provisions (Title I) of the 1990 Clean Air Act Amendments.



International Fabricare Institute

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January 29, 1991

COMMENTS ON THE DRYCLEANING NAPCTAC by William E. Fisher, Vice President

International Fabricare Institute appreciates the opportunity to address the members of the National Air Pollution Control Techniques Advisory Committee on the proposed perchloroethylene and 1,1,1--Trichloroethane drycleaning emission standards. IFI has worked closely with EPA's Emission Standards Division on drycleaning standards over the years, starting with the inception of the first perchloroethylene CTG and carrying through to today's work.

Based on our understanding of ESD's current directions and the material presented in the "Drycleaning NAPCTAC Package," we believe that the agency may likely propose standards which could be characterized as "tough but fair."

It is unfortunate, however, that there may be limited need for this standard if the Ozone & CO Branch of OAQPS continues its new policy of causing neighborhood drycleaners to be threatened with \$10,000 per day fines for not instantaneously adopting control equipment which may or may not be acceptable under the final ESD proposal.

I will provide further information on this for the NAPCTAC members later in my talk. First, however, I would like to offer our comments on the ESD Drycleaning Package.

Our understanding is that EPA is currently considering a "combination" standard for perchloroethylene drycleaners. While 98-100% of neighborhood drycleaners are expected to be sub-10 ton "area sources" to which Generally Available Control Technology (GACT) standards may be applied, we understand that the Agency is considering a "combination" standard. Specifically, we understand that ESD is evaluating a MACT-like standard for new facilities, and a BACT/RACT standard for existing facilities.

While this approach would go well beyond GACT standards, we believe that it makes sense and will result in good control without severe economic disruption or plant closures. However, as indicated to the ESD in a meeting in 1990, careful consideration must be given to those facilities which undergo "reconstruction" in the future.

Specifically, the smallest neighborhood drycleaning stores in our industry are those of concern. As background, let me note that in the just-released 1987 Census of Business statistics, 37% of neighborhood drycleaning stores reported gross annual receipts averaging \$74,000 or less.

Small plants of this type--which are often the sole source of drycleaning in a small town of 5,000-10,000 population--will hopefully be able to afford the approximate \$6,000-\$8,000 for add-on emission control devices. However, if in the future this type of small plant needs to replace their drycleaning machine--ie, the "facility" itself--they may be viewed as a reconstructed facility subject to new source MACT standards.

In this case, MACT will likely be a \$30,000-\$50,000 dry-to-dry no-vent refrigerated drycleaning machine. Not only will plants of the small size just described not be able to afford capital expenditure of this magnitude, they will have already have made a capital investment in add-on controls. For such a plant, then, the only realistic option would be closure.

IFI has suggested a course of action to ESD for this situation. Specifically, we recommend that the Agency determine an economic break-point for reconstructed facilities. Above the break-point, facilities would have sufficient capital to proceed with no-vent refrigerated machines; below the break-point, facilities would be permitted to replace existing transfer equipment with a like kind--with continued use of emission controls.

Some further comments on the ESD package:

- o For the sake of clarity, we suggest that references in the package to "dry-to-dry machines" always be specified as "standard vented dry-to-dry" or "no-vent refrigerated dry-to-dry." These two types of machines represent BACT/RACT and MACT respectively, and the distinction will be a critical one for future readers of the package.

The document states that "approximately 67% of the drycleaning industry uses dry-to-dry machines and 33% use transfer machines." As noted in a December 26, 1989 letter to ESD on this, our analysis indicates that the distribution is approximately 42-50% transfer, 25-35% vented dry-to-dry, and 23-25% no-vent refrigerated dry-to-dry. We will be happy to review these numbers--collected by IFI and other industry sources--with ESD.

- o It was surprising to learn that EPA is also planning to propose an emission standard for 1,1,1--Trichloroethane plants. Currently, there are only approximately 50 such plants in the United States, and there are unlikely to be any additional. Only one type of equipment has been made for 1,1,1--ie, no-vent refrigerated machines--and by definition and actuality these represent MACT. If EPA's intent is to propose a standard based on that equipment with appropriate work practices, we would support such a move.

- o The document notes that "emissions from spent cartridge filters and solid waste" contribute to fugitive emissions. Based on data supplied by waste recyclers serving the drycleaning industry, approximately 73% of all neighborhood drycleaning facilities are using hazardous waste disposal (ie, recycling). As almost 20% of the industry consists of petroleum solvent plants--who are less likely to use hazardous waste disposal--we estimate that approximately 85+% of all perc plants are using hazardous waste disposal, and therefore have no fugitive emissions from cartridge filters or solid waste. (As a minor note, we calculate that an average of 3.2 pounds perc/100 lbs of cleaning are lost in the waste from an average neighborhood drycleaning store, rather than the 2.5lbs/100 lbs. cited in the document.)
- o The NAPCTAC packet notes that the standard "...could be written to ensure that the replacement occurs requiring use of the dry-to-dry technology in existing machines..." While the language is somewhat unclear here, we trust that this is not a suggestion for requiring immediate replacement of all transfer or standard vented dry-to-dry machines with no-vent refrigerated machines. As briefly indicated by the prior discussion on affordability, such a course could result in the closure of one-third to one-half of the industry.

I would like to conclude my presentation by reviewing what I believe can truthfully be characterized as a deplorable and unwarranted action being taken by branch within OAQPS.

When EPA first began proposing standards for perchloroethylene drycleaners in 1976, the industry questioned OAQPS as to their certainty of the photochemical reactivity of perc. The answer given to us was an unqualified "yes"--and we accepted that answer. In 1983, however, Dr. Basil Dimitriades of EPA's ORD published an EPA report which concluded:

"In fact, PCE contributes less to the ambient O3/OX problem than equal concentrations of ethane."

In an October 24, 1983 Federal Register notice the Agency proposed including perchloroethylene on the list of compounds with negligible photochemical reactivity. In the intervening eight years, the Agency has somehow managed to not finalize that proposal, despite reaffirming the negligible reactivity of perc in internal memos since that time.

A problem? No, not until the applicable branch within the Air Office began instructing EPA's Regional Offices to absolutely require any state with a "deficient" State Implementation Plan to begin immediately enforcing previous CTG requirements on the basis of "reactivity" and "suspected carcinogenicity."

In a word, this conduct is outrageous. Not only has perc been found by EPA itself to be non-reactive--and its official Agency designation remains as a C "possible" carcinogen--the process of standards setting is designed to be handled through the procedures which we are intimately involved with today--not by an executive fiat by one branch.

Moreover, there are no guarantees or assurances at this time as to the final control requirements which will appear in the ultimate drycleaning standard--meaning that small facilities now being threatened with \$10,000 per day fines may well purchase equipment which is deemed to be unacceptable within a year's time. I urge the NAPCTAC members to refute this ill-advised action by a part of the Agency.

If I can answer any questions or provide any additional information, I would be happy to do so. Thank you.

VIII. ETHYLENE OXIDE COMMERCIAL STERILIZERS
BACKGROUND INFORMATION AND REGULATORY ALTERNATIVES

EPA PRESENTATIONS

STATUS REPORT

MR. David Markwordt

Emission Standards Division
U.S. Environmental Protection Division
Research Triangle Park, NC 27711

(Slide 1)

I would like to present the status of our work to develop ethylene oxide (EO) standards for commercial sterilization/fumigation facilities.

(Slide 2)

I will review the background information including the sterilization process and emission controls and the regulatory alternatives.

(Slide 3)

Title III of the Clean Air Act lists EO as a hazardous air pollutant. This category includes commercial sterilization and fumigation facilities that use EO as a sterilant gas. Data gathering began in 1985. Numerous meetings with the public have taken place since then and a status report was presented to NAPCTAC in May of 1988. An Alternative Control Technology Document was published in March 1989 providing basic process information and environmental control information.

(Slide 4)

The types of industries which sterilize/fumigate with EO are listed on slide 4. Although this is a diverse group of industries the sterilization/fumigation process is the same for each industry.

(Slide 5)

Here is a summary of the sterilization/fumigation cycle. Presterilization conditioning consists of heating and humidifying the product in a separate room prior to sterilizing; this will facilitate the penetration of EO into the product. After conditioning the product is placed in the empty sterilization chamber. The air in the chamber is then pumped out and then the chamber is filled with either pure EO or a mixture of EO and chlorofluorocarbons or EO and CO₂. When sterilization is complete, the chamber vacuum pump is used to evacuate the chamber. This pumping lasts at least 10 minutes. The pump is turned off; and

air or other gases, such as N₂ or CO₂, is used to fill the chamber to increase the rate at which EO is diffusing from the product. This "air wash" lasts from 2 to 15 minutes. The evacuation/air wash steps are repeated until the desired amount of EO has been pumped from the chamber. At the completion of the last evacuation, the chamber door is opened and a fan at the rear of the chamber is turned on to draw room air through the chamber. This air flow protects the workers by drawing EO to the rear chamber exhaust vent; this exhaust is vented to the atmosphere. Chamber exhaust emissions are a function of the number of evacuation/air wash cycles.

(Slide 6)

Limited test data support that approximately 95% of the EO is pumped from the chamber and approximately 5% is left in the product and the chamber. It is assumed that 2% of the EO (40% of 5%) is vented through the chamber exhaust and 3% of the EO (60% of the 5%) off-gases in the warehouse (aeration). Not all facilities use chamber exhaust; for these facilities 5% of the EO would off-gas in the warehouse.

(Slide 7)

Vent emission characteristics are presented in this slide.

(Slide 8)

Candidate control technology for maximum achievable control technology (MACT) is summarized in Slide 8. Although control levels for aeration and chamber exhaust vent streams are uncertain, for the purpose of estimating national emission reduction and control cost impacts a control efficiency of 98% was used.

(Slide 9)

This part of the presentation will deal with the thought process used to develop the preliminary regulatory alternatives.

(Slide 10)

Title III of the CAA provides the authority to subcategorize facilities based on class, type, and size. In assessing the similarity/dissimilarity of facilities, industry classes, EO use, economics, and cost effectiveness data were analyzed.

(Slide 11)

Slide 11 shows the number of existing facilities with and without emission controls on the main vent for seven industry groups.

(Slide 12)

Slide 12 presents a bar chart displaying the number of facilities versus EO use for various EO use ranges and the number of facilities controlling the main sterilizer vent.

(Slide 13)

Results of the economic analysis will be presented next.

(Slide 14)

The economic analysis showed significant effects for two industry groups as summarized on slide 14.

(Slide 15)

A staff preliminary similarity determination indicates that museums and libraries and laboratories may be dissimilar to the other industry groups because of the possible dissimilarity criteria listed on slide 15.

(Slide 16)

The cost of reducing a metric ton of pollutant per facility will be reviewed as a possible indicator of dissimilarity.

(Slide 17 and 18)

The sterilizer and aeration vent cost effectiveness versus EO use were plotted for each uncontrolled facility on slides 17 and 18 respectively. As reflected in the plots, cost effectiveness improves with increasing EO use but there are no clear clustering or gaps in the plot that suggest industry groups are dissimilar.

(Slide 19)

The preliminary staff EO sterilizer similarity determination included an analysis of the sizes, types, and classes of facilities, economic impacts, and cost effectiveness as previously shown.

(Slide 20)

The preliminary staff similarity determination conclusions are summarized in slide 20.

(Slide 21)

Preliminary regulatory alternatives are presented on slide 21. The control requirement for the main sterilizer is 99%. The control reduction used to estimate impacts for add-on controls for aeration and chamber exhaust vents is 98%. For alternatives D and C, the requirements for the chamber exhaust vent is to not exceed current emission levels; therefore there are no cost or emission impacts associated with maintaining the status quo for chamber exhaust in alternatives D and C.

(Slide 22)

There were numerous analysis used to establish the regulatory alternatives in addition to those shown on slide 21. Some examples are shown here on slide 22.

(Slide 23)

The project schedule is summarized on slide 23.

**NAPCTAC
STATUS REPORT:
ETHYLENE OXIDE STANDARD
FOR COMMERCIAL
STERILIZATION/FUMIGATION
FACILITIES**

JANUARY 31, 1991

ORGANIZATION OF PRESENTATION

➔ ○ BACKGROUND INFORMATION

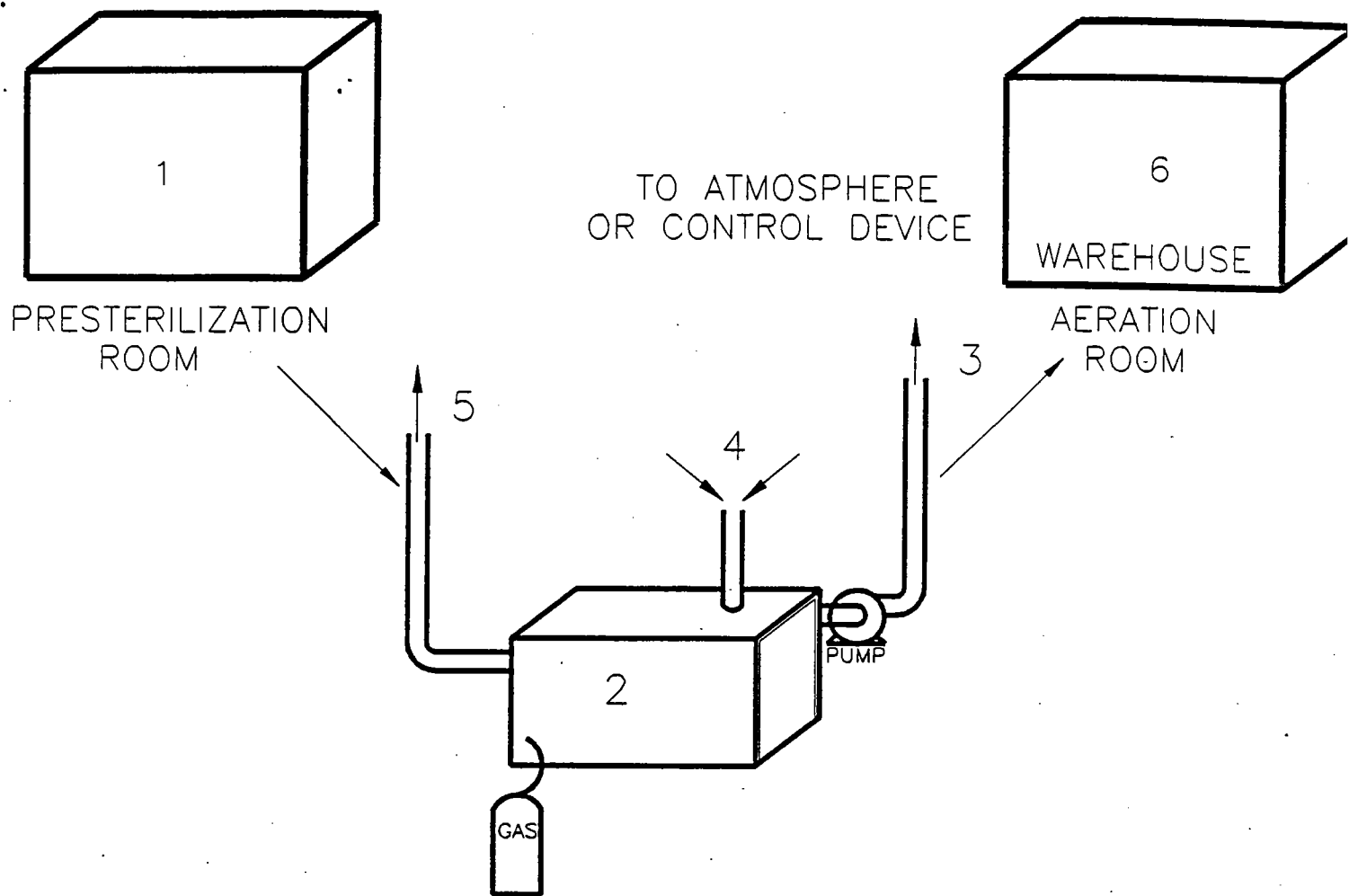
○ REGULATORY OPTIONS

BACKGROUND

- TITLE III LISTS ETHYLENE OXIDE (EO) AS A HAZARDOUS AIR POLLUTANT
- CATEGORY INCLUDES COMMERCIAL STERILIZATION AND FUMIGATION FACILITIES THAT USE EO AS A STERILANT GAS
- DEVELOPMENTAL MILESTONES:
 - BEGAN DATA GATHERING--
OCTOBER 1985
 - HIMA MEETINGS
 - NAPCTAC MEETING--MAY 1988
 - ALTERNATIVE CONTROL
TECHNOLOGY DOCUMENT--
MARCH 1989

TYPES OF INDUSTRY

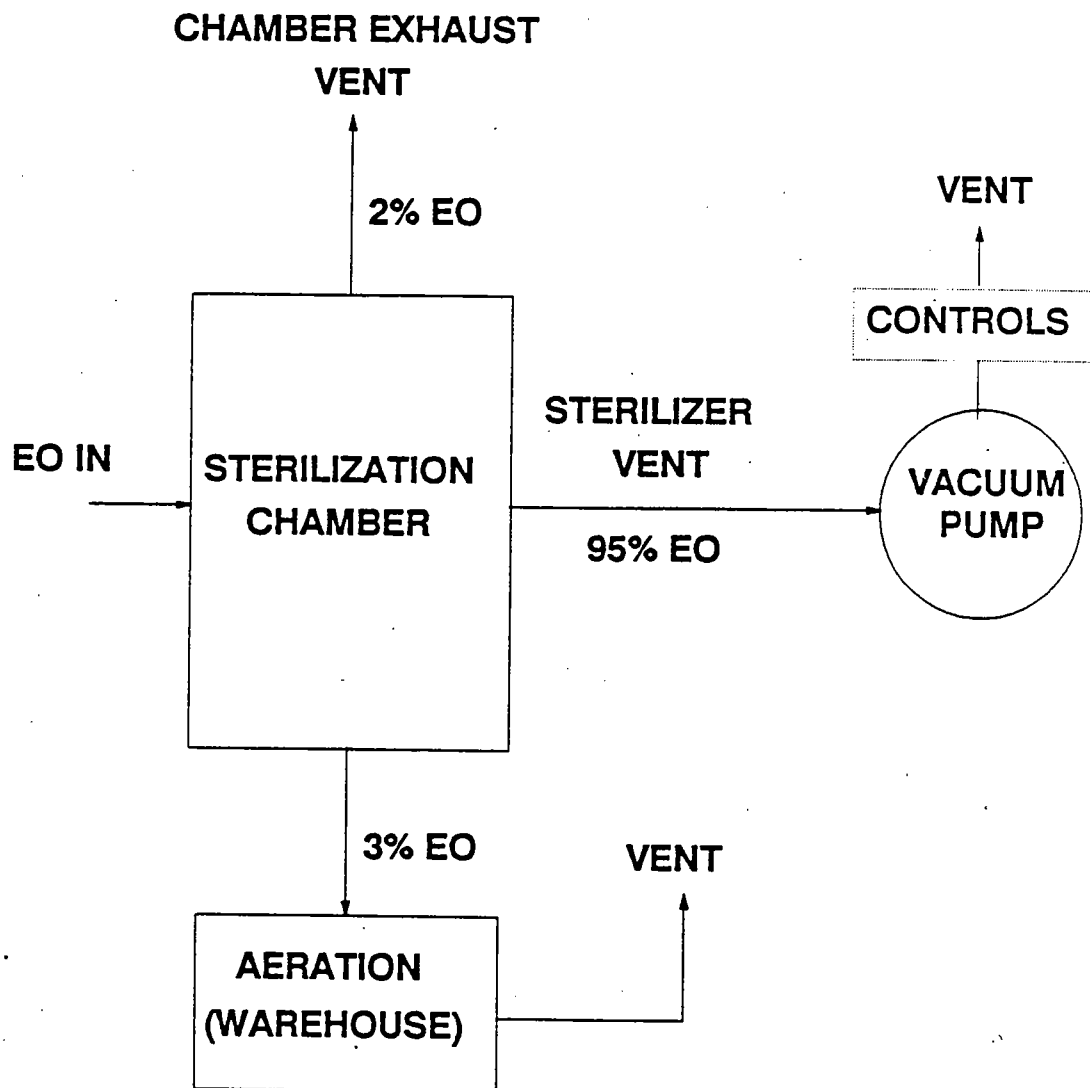
INDUSTRY GROUP	TOTAL FACILITIES
MEDICAL EQUIPMENT SUPPLIERS	61
PHARMACEUTICALS	39
OTHER HEALTH-RELATED INDUSTRIES	24
SPICE MANUFACTURERS	23
CONTRACT STERILIZERS	18
LIBRARIES, MUSEUMS, AND ARCHIVES	13
LABORATORIES (RESEARCH, TESTING, AND ANIMAL BREEDING)	10
TOTAL	188



THE STERILIZATION CYCLE

- 1 ○ PRESTERILIZATION
CONDITIONING
- 2 ○ STERILIZATION
- 3 ● EVACUATION
- 4 ○ AIR WASH
- 5 ● CHAMBER EXHAUST
- 6 ● AERATION
- EMISSION POINTS

EMISSIONS SPLIT



VENT EMISSIONS CHARACTERISTICS

VENT	MAXIMUM CONCENTRA- TION (PPM)	FLOW RATE (FT ³ /MIN)	NATIONWIDE EMISSIONS (MG/YR)
STERILIZER	400,000	300	980
AERATION ROOM	<30	> 10,000 ^a	57
CHAMBER EXHAUST	15,000	1,500- 3,000	38

^aAERATION CONTROL COST ANALYSIS BASED ON FLOWRATE OF 250 FT³/MIN FOR EACH AERATION UNIT.

CANDIDATE CONTROL TECHNOLOGY FOR MACT

EMISSION POINT	CONTROL LEVEL	COMMENTS
STERILIZER VENT	>99%	<ul style="list-style-type: none"> • ACID-WATER SCRUBBERS, CATALYTIC OXIDIZERS • DEMONSTRATED CONTROL THROUGHOUT CS INDUSTRY (30 FACILITIES) • APPLIED ACROSS INDUSTRY TYPES AND FOR A WIDE RANGE OF FACILITY SIZES (130-10,000 FT³)
AERATION ROOM	UNCERTAIN	<ul style="list-style-type: none"> • CATALYTIC OXIDIZERS, GAS/SOLID REACTORS • CONTROLS AT 6 FACILITIES
CHAMBER EXHAUST	UNCERTAIN	<ul style="list-style-type: none"> • NO CONTROLLED FACILITIES • CATALYTIC OXIDIZERS, GAS/SOLID REACTORS (TRANSFER OF TECHNOLOGY)

ORGANIZATION OF PRESENTATION

☐ **BACKGROUND INFORMATION**

➔ ☐ **REGULATORY OPTIONS**

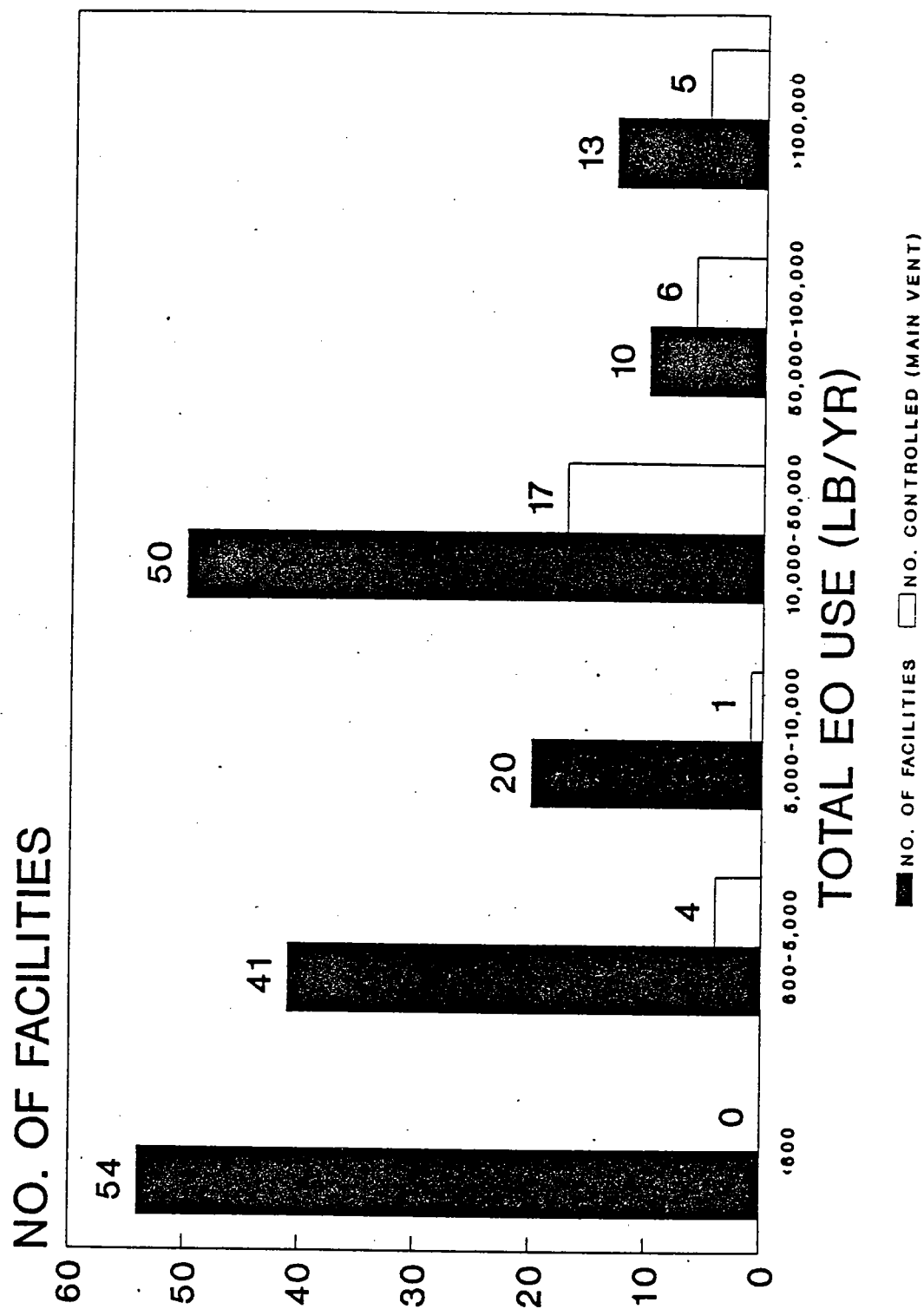
SIMILARITY TESTS

- ➔ ● **FACILITIES**
 - **CLASSES**
 - **TYPES**
 - **SIZE**
- **ECONOMICS**
- **COST EFFECTIVENESS**

EXISTING CONTROLLED FACILITIES' STERILIZER VENTS

INDUSTRY GROUP	TOTAL FACILITIES	CONTROLLED FACILITIES	CONTROLLED (%)
MEDICAL EQUIPMENT SUPPLIERS	61	16	26
PHARMACEUTICALS	39	4	10
OTHER HEALTH-RELATED INDUSTRIES	24	3	12
SPICE MANUFACTURERS	23	4	17
CONTRACT STERILIZERS	18	6	33
LIBRARIES, MUSEUMS, AND ARCHIVES	13	0	--
LABORATORIES (RESEARCH, TESTING, AND ANIMAL BREEDING)	10	0	--
TOTAL	188	33	18

FACILITIES VS. EO USE



SIMILARITY TESTS

- FACILITIES
 - CLASSES
 - TYPES
 - SIZE
- ➔ ● ECONOMICS
 - COST EFFECTIVENESS

ECONOMIC IMPACTS

SIGNIFICANT EFFECTS FOR TWO INDUSTRY GROUPS

1. MUSEUMS AND LIBRARIES

- VERY LOW EO USE (<0.1 PERCENT OF EO EMISSIONS)
- COST OF STERILIZATION SIGNIFICANTLY INCREASED
- COST OF CONTROLS MAY REPRESENT A LARGE FRACTION OF BUDGET
- VERY HIGH COST EFFECTIVENESS: \$200,000 TO \$8,300,000 PER MG
- LACK OF VIABLE SUBSTITUTES

2. LABORATORIES

- STERILIZATION COSTS ARE A SMALL FRACTION OF TOTAL PRODUCTION COSTS AS ESTIMATED BY SALES
- LOW EO USE (< 1 PERCENT OF EO EMISSIONS)
- HIGH COST EFFECTIVENESS
- LIMITED SUBSTITUTION POSSIBILITIES

PRELIMINARY STAFF "SIMILARITY" DETERMINATION

POSSIBLE DISSIMILARITY CRITERIA

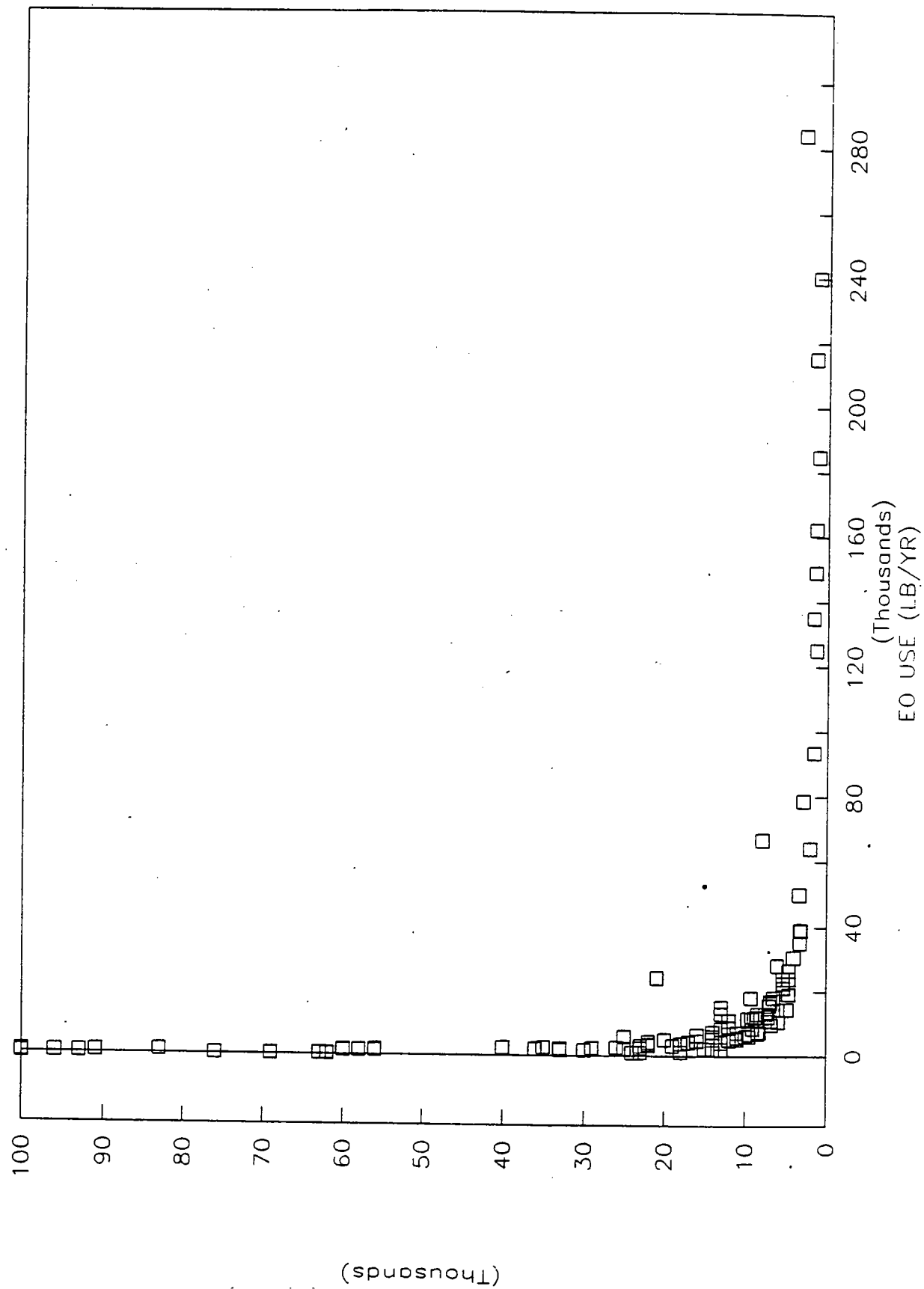
INDUSTRY GROUP	DISSIMILARITY
MUSEUMS AND LIBRARIES	<ul style="list-style-type: none">• NO FACILITIES CURRENTLY CONTROLLED*• VERY LOW ANNUAL EO USE (HIGH COSTS PER UNIT OF EO USED)• UNIQUE MARKET CHARACTERISTICS
LABORATORIES	<ul style="list-style-type: none">• RESEARCH LABS (SIC 7391) HAVE PARTICULARLY HIGH COSTS PER UNIT OF EO USED• NO FACILITIES CURRENTLY CONTROLLED• UNIQUE MARKET CHARACTERISTICS

***EXCLUDES RECENT CALIFORNIA LEGISLATION**

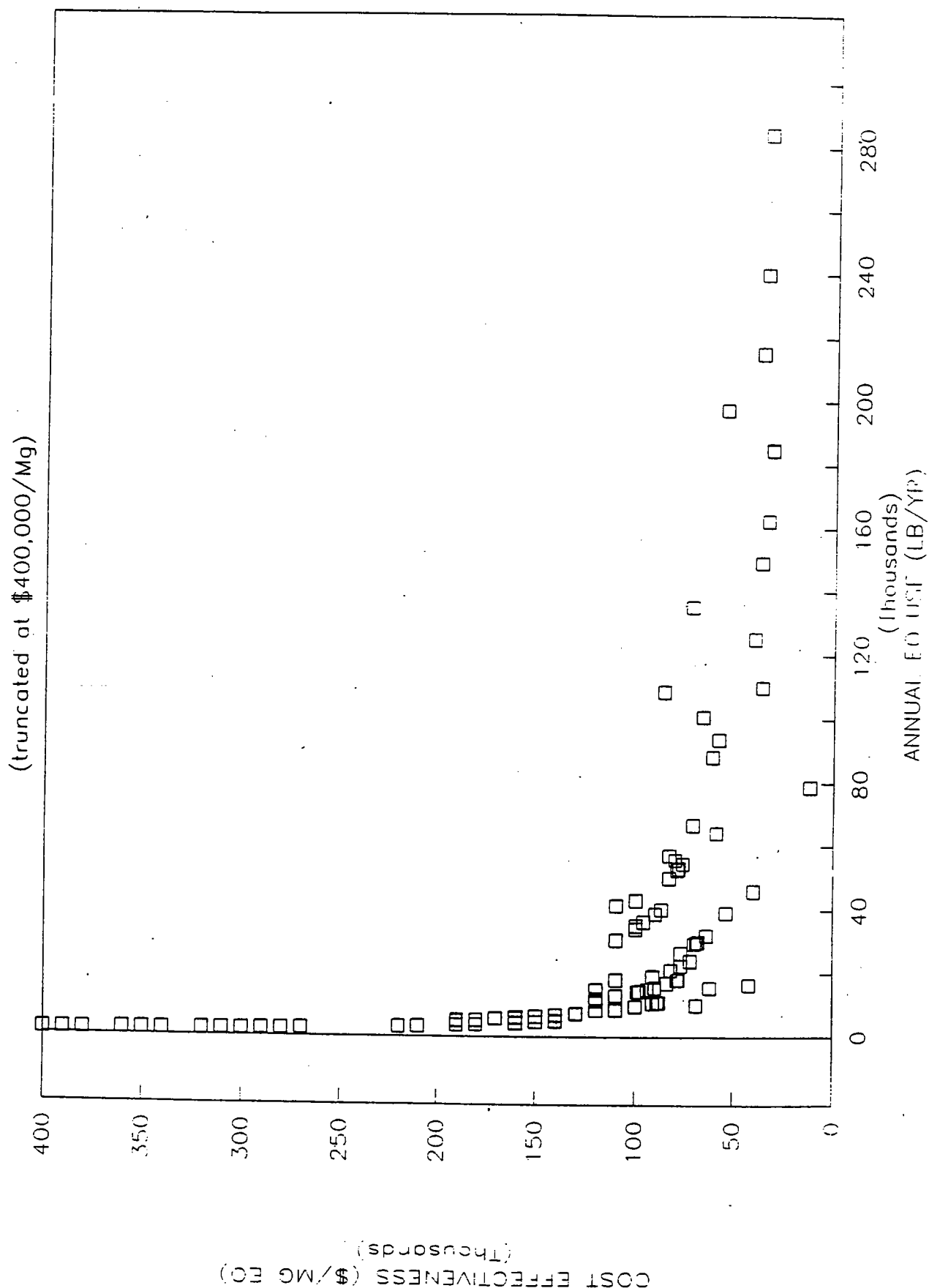
SIMILARITY TESTS

- FACILITIES
 - CLASSES
 - TYPES
 - SIZE
- ECONOMICS
- ➔ ● COST EFFECTIVENESS

STERILIZER VENT COST EFF. VS. EO USE



AERATION COST EFFECTIVENESS VS. EO USE



PRELIMINARY STAFF EO STERILIZER SIMILARITY DETERMINATION

I. FACILITIES (SIZES, TYPES, ETC.)

II. ECONOMICS

III. COST EFFECTIVENESS

- **LIBRARIES AND MUSEUMS ARE
HIGHER**

PRELIMINARY STAFF EO STERILIZER SIMILARITY DETERMINATION

CONCLUSIONS

- WHAT IS SIMILAR/DISSIMILAR IS NOT DISTINCTLY CLEAR
- FACILITIES THAT USE LESS THAN 600 LB/YR EO TEND TO BE DISSIMILAR FROM OTHER FACILITIES
- SUBCATEGORIZE FACILITIES INTO TWO GROUPS:
 - FACILITIES USING < 600 LB/YR EO
 - FACILITIES USING > 600 LB/YR EO
- > 12 PERCENT OF ALL FACILITIES THAT USE OVER 600 LB/YR EO HAVE STERILIZER VENT CONTROLS-- MEETS FLOOR REQUIREMENT
- WHAT ADDITIONAL CONTROLS (IF ANY) SHOULD BE REQUIRED AS PART OF MACT?
 - EO STERILIZERS WITH < 600 LB/YR EO USE
 - AERATION ROOMS

REGULATORY ALTERNATIVES

REGULATORY ALTERNATIVE	EO USE CUTOFF			CHAMBER EXHAUST ^a	TOTAL ANNUAL COSTS (\$/MM)	EMISSION REDUCTION AND RESIDUAL (MG/YR)	COST EFFECTIVENESS (\$/MG)
	NATIONWIDE EMISSION REDUCTION (%)	STERILIZER VENT (LB/YR)	AERATION ROOM (LB/YR)				
A	99	25	25	ADD-ON CONTROLS	12.0	1,061 (11)	11,300
B	97	600	40,000	ADD-ON CONTROLS	9.2	1,042 (30)	8,800
C	94	600	40,000	STATUS QUO	6.4	1,004 (68)	6,400
D	90	600	N/A	STATUS QUO	4.3	967 (105)	4,500

^aCutoff same as sterilizer vent.

TOTAL ANNUALIZED COSTS

- AS A PERCENTAGE OF STERILIZATION COSTS
- AS A PERCENTAGE OF SALES
- RELATIVE TO EO USE
- RELATIVE TO CHAMBER VOLUME

PROJECT STATUS

PROPOSE STANDARD

SPRING 1992

PROMULGATE STANDARD

SPRING 1993

DISCUSSION

Following the presentation, Mr. Paul Arbesman inquired, concerning the setting of emissions standards, whether "use" as presented in the Status Report equate to emissions of ethylene oxide. Mr. David Markwordt responded that for uncontrolled facilities, "use" did equate to emissions of ethylene oxide. Mr. Arbesman also inquired if the 10 ton per year (ton/yr) (major source) cutoffs used in the analyses were contained in the Status Report. Mr. Markwordt responded that of the 188 facilities in the data base, approximately 20 can be considered major sources according to the 10 ton/yr cutoff. However, since the process and applicability of controls is the same for sources whether they are above or below the major source cutoff, EPA chose to apply MACT to major and area sources.

Mr. John Pinkerton noted that vacuum pumps were not mentioned in the presentation but were discussed in the preliminary material. Mr. Markwordt responded that vacuum pumps are used to evacuate the chamber after sterilization. Some of the pumps use water as a once-through circulatory fluid, which results in ethylene oxide being discharged to the drain. These types of pumps were noted in previous industry survey data. The data currently available indicate that in most facilities, these types of pumps have been replaced with recirculating pumps that do not present the ethylene oxide discharge problem. However, the costing calculations in the economic impact section did account for the replacement of the recirculating vacuum pumps. Mr. Pinkerton also noted that some aeration rooms, with their

high-flow, low-concentration ethylene oxide emission streams, are controlled. He asked why chamber exhausts, which typically exhibit lower flows and higher concentration, are uncontrolled. The gas stream characteristics of the chamber exhaust streams should make them easier to control than aeration room exhaust streams. Mr. Markwordt responded that of the aeration room exhaust streams currently controlled, airflows are reduced by using separate chambers for control versus ducting air from the warehouse to a common control device. The EPA costing methodology also used this approach. The aeration room exhaust stream characteristics presented in Slide 7 represent the exhaust flows from uncontrolled, warehouse-type facilities.

Additionally, Mr. Pinkerton asked if States currently regulated sources of ethylene oxide, and why hospitals were not addressed in these guidelines. Mr. Markwordt responded that many States do regulate the emissions of ethylene oxide; for example California has recently promulgated stringent regulations. Hospitals will be regulated as a separate source category. Six thousand to 7,000 hospitals sterilize using ethylene oxide (versus less than 200 in the commercial sterilization category), and each hospital generally uses much less ethylene oxide than commercial sterilizers.

Mr. William O'Sullivan commented that, concerning cost effectiveness figures, the most environmentally protective control option appeared to be within the allowable economic

impacts and asked why this option is not the recommended staff option. Mr. Markwordt responded that the cost-effectiveness figures in this case are the result of averaging the costs across the full spectrum of ethylene oxide sterilant users. The actual costs to an infrequent, small-volume, ethylene oxide user would be considerably higher. Mr. Weigold added that incremental costs of the regulatory alternatives should also be considered.

Ms. Deborah Sheiman stated that the Agency should set the standard to eliminate emissions from uncontrolled facilities, not set it so that certain groups are excluded from its provisions. In other words, she requested that the EPA use the standard to encourage centralization of ethylene oxide sterilization activities. Mr. Markwordt explained that the nature of the industry for several of these smaller sterilizing units (such as those at libraries) is that they sterilize valuable items that they would prefer not to turn over to independent, contract sterilizers. However, where possible, centralized units would be encouraged because of the additional expenses that would be incurred because due to the proposed control options. In fact, the industry is already moving toward the increased use of contract sterilizers.

Ms. Sheiman also asked if alternatives to the use of ethylene oxide were pursued. Mr. Markwordt explained that substitute sterilants (including gamma radiation) were investigated, but that the Agency must also consider that there may be significant health effects if the alternatives produce

less- effective sterilants. The standard will be written to require a reduction in ethylene oxide use, and anyone in industry who can and wants to convert to a nonethylene oxide method certainly can. Mr. William Dennison added that the requirement to use a substitute, and thus reduce ethylene oxide 100 percent, is more appropriate to a case-by-case best alternative control technology (BACT) type of analysis than a NESHAP.

Mr. Ralph Hise stated that centralized contract sterilization facilities would reduce costs for all concerned and would also improve emissions efficiency. Mr. Hise also stated that using chamber exhaust systems seems redundant or unnecessary, and asked why their elimination is not required. Mr. Markwordt responded that these exhaust systems have already been put in place at a number of facilities to reduce worker exposure to ethylene oxide and to comply with OSHA regulations. At facilities that are running at full capacity, eliminating the chamber exhaust would require the facility to add additional sterilization capacity to allow the time to sufficiently evacuate the chamber to meet the OSHA requirements. Mr. Hise also asked how dangerous ethylene oxide is and stated that it would be helpful in the discussions to know the relative risks posed by the compound.

Dr. Patrick Atkins disagreed that all sources of ethylene oxide should be regulated. He encouraged EPA to consider subdividing the source category for regulation.

Mr. William Dennison noted that ethylene oxide, even in small quantities, could pose significant health risks because it tends to be emitted in residential areas. He stated that the ethylene oxide standard should be an interesting test case for residual risk standards.

Mr. Charles Collins asked if there were other uses/users of ethylene oxide not covered by these regulations and if so, how these sources would be regulated. Mr. Markwordt responded that additional sources did exist and that they would be addressed by the Hazardous Organics NESHAP. Mr. Collins also asked what the percentage of total ethylene oxide used by the sources covered under this NESHAP was, and Mr. Markwordt responded that this percentage could be determined. [In 1983, the facilities effected by this regulation used less than 0.1 percent of the ethylene oxide produced. However, these facilities accounted for over 60 percent of the National emissions of ethylene oxide in that year.¹]

After this discussion, Mr. Tim Walsh of the Donaldson Company, Inc., presented test results for a catalytic oxidation unit indicating between 98 and 99.9 percent efficiency. In no

¹Sources of Ethylene Oxide Emissions. U. S. Environmental Protection Agency. Office of Air Quality Planning and Standards. EPA-450/3-95-014. 1985.

case was ethylene oxide detected at the downstream sampler (detection limit 0.5 parts per million). He stated that an emission reduction efficiency of 98 to 99 percent was readily attainable using either Donaldson's [proprietary], or other companies) catalytic oxidation units to control emissions from both sterilization rooms and aeration rooms.

Following this presentation, Ms. Deborah Sheiman requested EPA's reaction to the information presented by Mr. Walsh. Mr. James Weigold responded that EPA welcomes any data presented by the public; however, the Agency cannot endorse any products or processes and does not intend that this forum be used as a means of [advertising] any particular products or processes.

CATALYTIC OXIDATION TO CONTROL ETO EMISSIONS

OVERVIEW

Donaldson Company, Inc. performed testing under supervision of Midwest Research Institute and the United States EPA on an ethylene oxide control unit at Seamless, a division of Professional Medical Products, Inc., Ocala, Florida. The control unit catalytically oxidizes ethylene oxide to carbon dioxide and water. Tedlar bag samples upstream and downstream of the catalytic cells were taken and analyzed on-site with a FID gas chromatograph. The efficiency of the control unit was found to be +99.5%-99.8%.*

*No EtO was detected downstream with a lower detection limit of .05 ppm, and 10-50 ppm upstream. This translates to an efficiency of 99.5+ to 99.8+%.

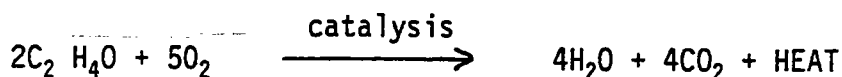
INTRODUCTION

On December 4 through December 6, 1989, Donaldson Co., Inc. conducted testing at Seamless, Ocala, Florida. Persons present at the testing were Tim Walsh and Nancy Klock, Donaldson Co., Inc., Frank Clay, U.S. EPA, and Sharon Srebro, Midwest Research Institute. The purpose of the testing was to demonstrate the efficiency of catalytic oxidation in controlling low concentration ethylene oxide (ETO) emissions from an aeration room.

PROCESS DESCRIPTION

Seamless, a division of Professional Medical Products, Inc. is a manufacturer of medical products. All products made at this facility are manufactured from either styrene or polypropylene. Products needing sterilization are placed into one of three sterilizers. The product is then sterilized with either 100% ETO or 12/88 ETO/freon depending on the sterilizer. Once the product has completed the sterilization process, it is placed into an aeration room where the product is allowed to offgas for 24 hours minimum. The room temperature is maintained at 100°F.

Ventilation for the aeration room is provided by two catalytic oxidizers, see Figure 1. These units were installed new in January 1986 and have been running 24 hours per day continuously since that time (4 yrs. of operation). The catalytic cells which were installed at start-up are still in service. The warm, low concentration ETO-laden air is drawn out of the room from ceiling vents and is ducted to the two catalytic oxidizers. Here the air is further heated by running through a heat exchanger and then steam coils where it is heated to 300°F before it enters the catalyst beds where ETO is removed from the air via the following equation:



The ETO-free air then exits through the blower and is ducted through the other side of the heat exchanger before it is returned to the aeration room via floor grates. Before entering the room some of the hot exhaust air is bled off to atmosphere to keep the room temperature at 100°F. This process continues as long as the catalytic oxidizer remains running.

SAMPLING AND ANALYTICAL PROCEDURES

For all of the measurements and sampling procedures, only one of the control units was tested; the pre-test survey of September 6, 1989 having shown the two units to be equivalent in measurement characteristics and performance.

The velocity of the airstream was measured upstream and downstream of the control unit using 12 traverse points in the 12" x 15" duct; see Figure 1 for locations. A standard type pitot tube was used. Airstream temperature was measured at the same locations. The average of the velocity readings was corrected to standard temperature and pressure to give the volumetric flowrate.

Upstream and downstream grab samples were taken simultaneously via test ports originally installed in the unit upstream and downstream of the catalytic cells. Sample size for all but two of the samples was 1 liter; for two of the samples 10-liter bags supplied by the EPA representative were used yielding samples of approximately four liters.

The grab samples were analyzed on a FID gas chromatograph at the site. Analysis took place within a few hours of sampling.

DISCUSSION OF RESULTS

In the analysis of the gas samples it was assumed that there had been no change in the ETO concentration as the samples were analyzed less than 24 hours after they were taken.

The maximum concentration in the aeration room was found to be considerably lower than that measured in the pre-test survey of September 6. During the pre-test survey 12/88 was used. At the time of the December testing 100% ETO was being used. The sterilizers draw a much higher vacuum during the evacuation with 100% ETO than with 12/88. This difference in sterilizer cycles is thought to have caused the difference in readings for the two tests.

SUMMARY OF RESULTS

Flowrate: 1033 SCFM

Range of ETO concentrations:

Upstream: 9.78 - 46.7 ppmv

Downstream: No ETO detected (Concentration below .05 ppm)

Efficiency: 99.4+ to 99.8+%

Results from GC analysis of Seamless samples - 12/5/89

	<u>Upstream (PPMV)</u>	<u>Downstream (PPM)</u>	<u>Efficiency (%)</u>
1	12.60	Below .05	99.5+
2	10.75		99.5+
3	11.89		99.5+
4	10.67		99.5+
5	9.77		99.4+
6	46.97		99.8+

Time of Sampling:

Bags 1-3 were taken approximately 3 hours before a fresh load was put into the aeration room.

Bags 4 & 5 were taken immediately before a fresh load was put into the aeration room.

Bag 6 was taken about $\frac{1}{2}$ hour after the fresh load.

Conclusion

Donaldson Company has demonstrated that control efficiencies higher than those proposed are achievable. We strongly recommend that the ethylene oxide NESHAP follow the example set by California legislation and require 99.9% efficiency for sterilizer control and 99% for aeration control.

FIELD TEST DATA FROM SEVERAL OTHER INSTALLATIONS

NOTE: Upstream concentrations above 300 ppm are considered sterilizer IGR (Initial Gas Removal), concentrations below this are considered aeration.

CONCENTRATION (PPM)			
SITE #	UPSTREAM	DOWNSTREAM	EFFICIENCY
1	1013.5	.08	99.9%+
2	4409	Below .05	Above 99.9+%
3	3451	.8	99.9+%
4	157	.73	99.5%
5	687	.10	99.9+%
6	2765	.12	99.9+
7	1668	.09	99.9+%
8	314	.06	99.9+%
9	10	Below .05	Above 99.5+%
10	169	Below .05	99.9+%

Catalytic oxidation is an effective method to control both sterilizer exhaust (IGR) and aeration concentration.

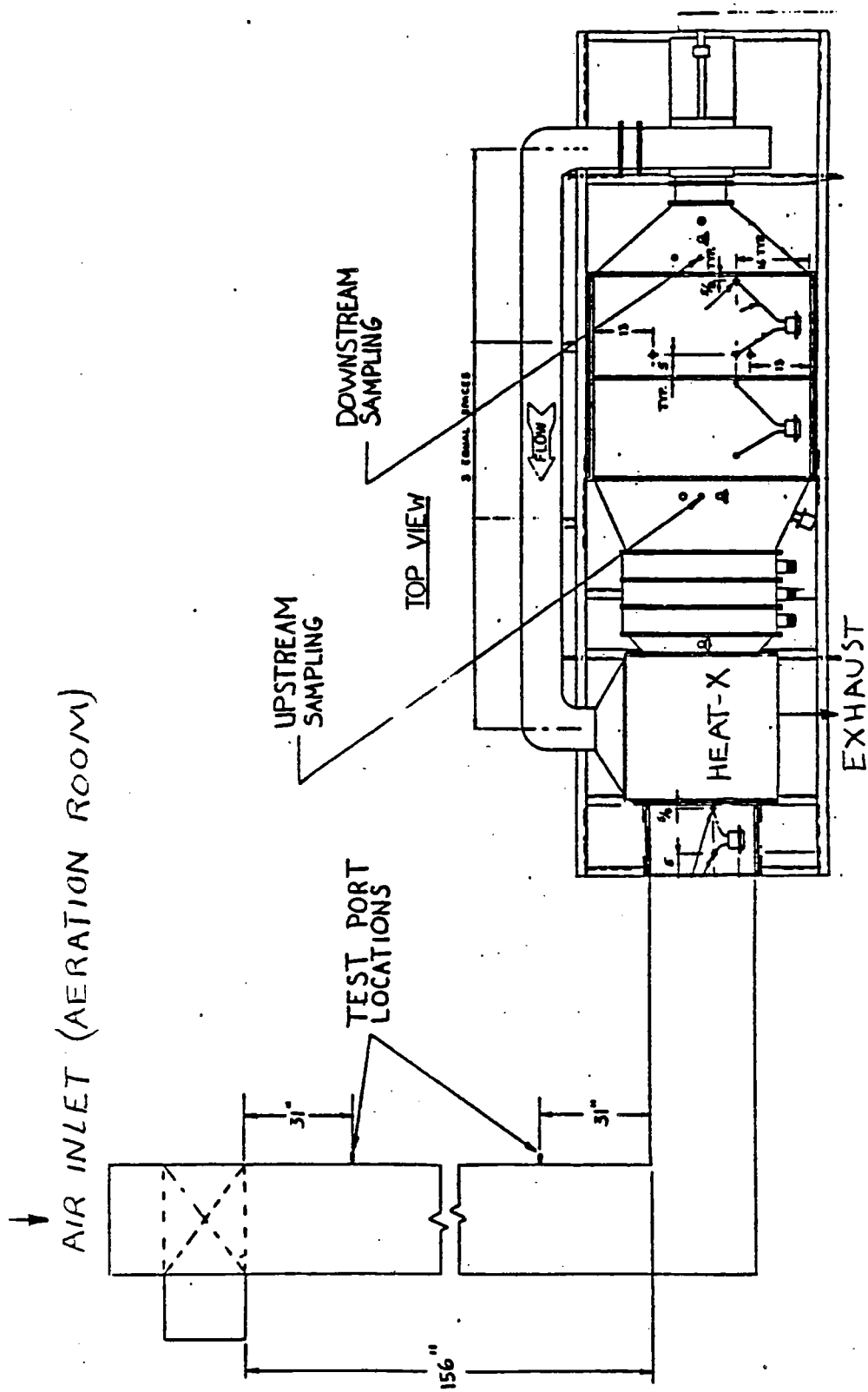


FIG. 1

IX. Chromium Electroplating and Chromic Acid
Anodizing NESHAP

EPA PRESENTATION

Mr. Andrew Smith
Mr. Lalit Banker
Emission Standards Division
U.S. Environmental Protection Agency
Research Triangle Park, North Carolina 27711

SUMMARY

Mr. Andrew Smith and Mr. Lalit Banker briefed the committee on the status of the NESHAP development for chromium electroplating and chromic acid anodizing operations. Mr. Smith presented technical background and Mr. Banker presented regulatory aspects. The attached charts provide the content of these presentations.

In summary, Mr. Smith began with a technical background section which briefly described the following:

1. source categories being regulated;
2. electroplating and anodizing processes;
3. industry profile in terms of number of operations and aggregate baseline emissions;
4. demonstrated control techniques to control chromium emissions from plating tanks and how they work;
5. estimated control technology capital and annualized costs;
6. existing level of control in the industry;
7. pollution prevention alternatives;
8. control equipment performance data gathered through our test program; and
9. current information on emerging technologies and our plan on how to determine their performances.

In summary, Mr. Banker described the regulatory alternatives that were developed, their nation-wide impacts, and current project schedule. Only one regulatory alternative was developed for decorative chrome electroplating and chromic acid anodizing based on fume suppressants as the control technology. This was due to the fact that fume suppressants achieve better control than other add-on control technologies and are less expensive. Use of trivalent chromium plating solution is being considered as an alternative method of achieving similar emission reductions for decorative chromium electroplating operations.

Five regulatory alternatives were developed for hard chrome electroplating operations. These five control options were developed based on three factors: (1) to account for emerging technologies being installed now which may become demonstrated soon, (2) to evaluate economic impacts resulting from these alternatives on small operations, and (3) to evaluate impacts of two control technologies with distinct levels of performance.

Mr. Banker then presented the nation-wide impacts (environmental and economic) of these regulatory alternatives. The impacts can be found in the attached charts. The committee was then informed of the current project schedule that calls for proposal by February '92 and promulgation by February '93. .

**CHROMIUM ELECTROPLATING
CHROMIC ACID ANODIZING
NESHAP**

**Briefing For
NATIONAL AIR POLLUTION CONTROL TECHNIQUES
ADVISORY COMMITTEE**

JANUARY 30, 1991

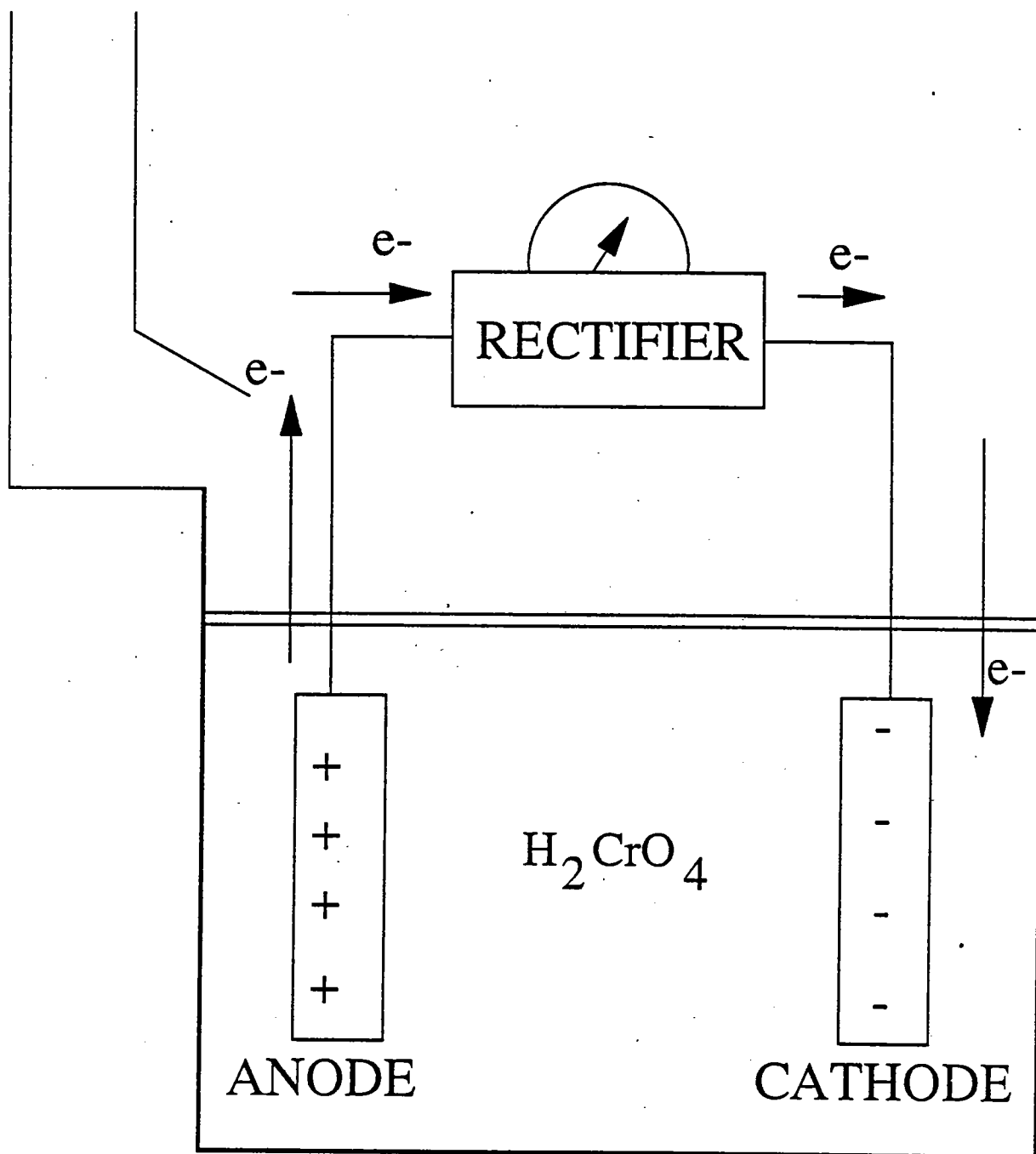
**By
Andy Smith
Lalit Banker**

OVERVIEW

- **PROCESS AND INDUSTRY DESCRIPTION**
- **CONTROL TECHNIQUES AND PERFORMANCE**
- **EXISTING LEVEL OF CONTROL**
- **EMERGING TECHNOLOGY**

BACKGROUND

- **CATEGORY INCLUDES CHROMIUM ELECTROPLATERS AND CHROMIC ACID ANODIZERS**
 - **EMISSIONS ARE CHROMIC ACID MIST**
 - **CHROMIC ACID IS A HEXAVALENT FORM OF CHROMIUM**
 - **HEXAVALENT CHROMIUM (CR^{+6}) IS A HUMAN CARCINOGEN WHICH CAUSES LUNG CANCER**
 - **ABOUT 5000 FACILITIES IN THE U.S.**
 - **ABOUT 170 TONS/YEAR OF CR^{+6} EMITTED**



ELECTROLYTIC CELL

FACTORS AFFECTING EMISSIONS

- **PRIMARY FACTOR IS AMOUNT OF CURRENT APPLIED**
 - **FORMATION OF HYDROGEN AND OXYGEN GAS IS DIRECTLY PROPORTIONAL TO CURRENT FLOW**
 - **GASSING AFFECTS/DRIVES MISTING**
- **OTHER FACTORS**
 - **TANK SURFACE AREA**
 - **SURFACE AREA PLATED**
 - **CHROMIC ACID CONCENTRATION**
 - **SURFACE TENSION OF PLATING BATH**

CHROMIUM ELECTROPLATING

HARD

ONE STEP PROCESS THAT DEPOSITS
A THICK LAYER OF CHROMIUM (> 1 MIL)

DECORATIVE

LAST STEP IN INTEGRATED SERIES OF PLATING AND
METAL FINISHING OPERATIONS THAT DEPOSITS A
THIN LAYER OF CHROMIUM (< 0.1 MIL)

FUNCTION • CORROSION RESISTANCE
• WEAR RESISTANCE
• LOW COEFFICIENT
OF FRICTION

• BRIGHT, REFLECTIVE FINISH
• TARNISH RESISTANCE
• WEAR RESISTANCE

EXAMPLES HYDRAULIC CYLINDERS
CRANK SHAFTS
INDUSTRIAL ROLLS

AUTOMOTIVE TRIM/BUMPERS
BATH FIXTURES
SMALL APPLIANCES

TIME HOURS

MINUTES

BATH 32 OZ/GAL CrO_3

32 OZ/GAL CrO_3

CHROMIC ACID ANODIZING

FORMS OXIDE FILM ON ALUMINUM

FUNCTION

CORROSION RESISTANCE

EXAMPLES

**AIRCRAFT SKIN
ELECTRONIC PARTS
SAILBOAT MASTS**

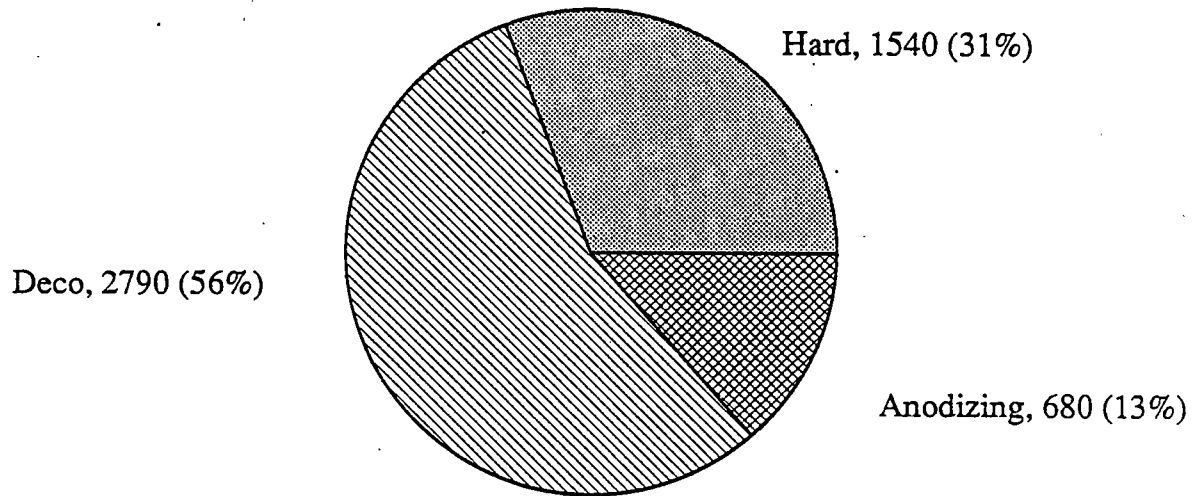
TIME

1/2 TO 1 HOUR

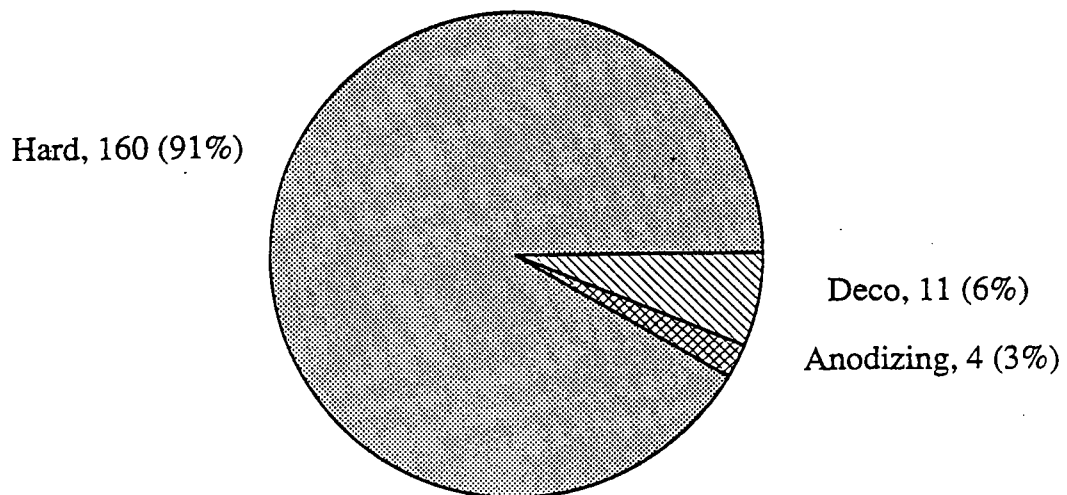
BATH

8 OZ/GAL CrO_3

NUMBER OF OPERATIONS



AGGREGATE BASELINE EMISSIONS OF CR+6 (Tons/year)



*All sources are < 10 tons/yr

CONTROL MEASURES

- **APPLY ADD-ON APCD**
- **INHIBIT MISTING WITH FUME SUPPRESSANTS**
- **CONVERT TO A NON-CHROMIC ACID PLATING PROCESS**

ADD-ON APCD

- **APPLICABLE TO ALL SOURCE CATEGORIES**
 - **CHEVRON-BLADE MIST ELIMINATORS, 95%**
 - **MESH-PAD MIST ELIMINATORS, 99%**
 - **PACKED-BED SCRUBBERS, >99%**
- **COMMON CHARACTERISTICS**
 - **CONTROL MECHANISM - IMPACTION**
 - **FABRICATED WITH PVC**
 - **NEED TO CLEAN WITH WATER**
 - **RECYCLE TO PLATING TANK**

ADD-ON CONTROL COSTS - HARD CHROME

	CAPITAL COSTS		
	SMALL	MEDIUM	LARGE
CHEVRON-BLADE	\$30,000	\$63,000	\$125,000
MESH-PAD	\$29,000	\$82,000	\$156,000
PACKED-BED	\$45,000	\$93,000	\$186,000

	ANNUALIZED COSTS		
	SMALL	MEDIUM	LARGE
CHEVRON-BLADE	\$6,000	\$12,000	\$24,000
MESH-PAD	\$9,000	\$27,000	\$59,000
PACKED-BED	\$11,000	\$27,000	\$43,000

CHEMICAL FUME SUPPRESSANTS

- **POLLUTION PREVENTION ALTERNATIVE**
 - **WETTING AGENT - REDUCES SURFACE TENSION**
 - **FOAM BLANKET - ENTRAPS MIST UNDER BLANKET OF FOAM**
 - **COMBINATION - WETTING AGENT/FOAM BLANKET**
- **GENERALLY APPLIED TO DECORATIVE AND ANODIZING, SELDOM APPLIED TO HARD**
 - **WETTING AGENTS CAUSE PITTING**
 - **FOAM BLANKET INCREASES DANGER OF HYDROGEN EXPLOSIONS**
- **ANNUAL COSTS**
 - **\$1,000/YR TO \$17,000/YR DEPENDING ON FACILITY SIZE**

TRIVALENT CHROMIUM PLATING PROCESSES

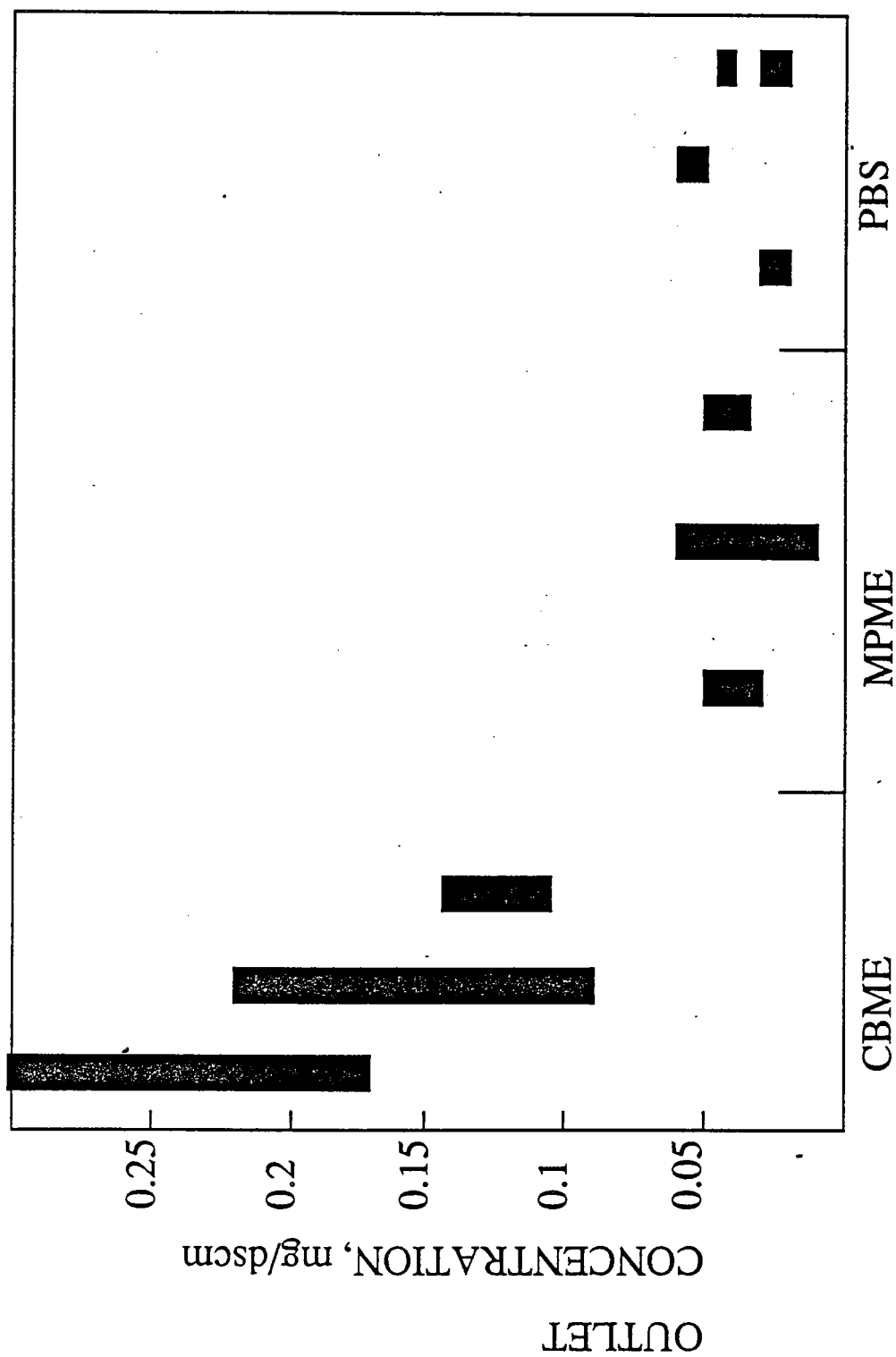
- **POLLUTION PREVENTION ALTERNATIVE**
- **APPLICABLE ONLY TO DECORATIVE PLATING**
- **USES CR^{+3} PLATING BATH INSTEAD OF CR_2O_3**
- **ENVIRONMENTAL ADVANTAGES**
 - **CONTAINS FOUR TIMES LESS CHROMIUM**
 - **CONTAINS NO CR^{+6}**
 - **FORMULATIONS CONTAIN WETTING AGENTS WHICH SUPPRESS MISTING**
- **USED IN ABOUT 100 OF 2800 DECORATIVE CHROMIUM FACILITIES IN THE U.S. (< 5% OF SOURCES)**
- **CAPITAL COST FOR CONVERSION IS HIGH**
 - **\$67,000 TO \$565,000 DEPENDING ON FACILITY SIZE**
- **ANNUALIZED COSTS ARE COMPARABLE TO CR_2O_3 PLATING**

LEVEL OF EXISTING CONTROLS

- **HARD PLATING OPERATIONS**
 - **30 % - UNCONTROLLED**
 - **30 % - CHEVRON-BLADE ME'S**
 - **40 % - PACKED-BED SCRUBBERS**
- **DECORATIVE PLATING OPERATIONS**
 - **15 % - UNCONTROLLED**
 - **5 % - PACKED-BED SCRUBBERS**
 - **40% - FUME SUPPRESSANTS**
 - **40 % - SUPPRESSANTS + SCRUBBERS**
- **CHROMIC ACID ANODIZING OPERATIONS**
 - **40 % - UNCONTROLLED**
 - **10 % - CHEVRON-BLADE ME'S**
 - **20 % - PACKED-BED SCRUBBERS**
 - **30 % - FUME SUPPRESSANTS**

PERFORMANCE DATA

- **CHEVRON-BLADE MIST ELIMINATORS (CBME)**
 - **WAVE TYPE**
 - **OVERLAPPING TYPE**
 - **OVERLAPPING TYPE, DOUBLE SET**
- **PACKED-BED SCRUBBERS (PBS)**
 - **SINGLE PBS WITH WASHDOWN**
 - **DOUBLE PBS WITH NO WASHDOWN**
 - **SINGLE PBS WITH AND WITHOUT WASHDOWN**
- **MESH-PAD MIST ELIMINATORS (MPME)**
 - **CBME FOLLOWED BY TWO PADS**
 - **TWO UNITS WITH DOUBLE PADS**
- **FUME SUPPRESSANTS**
 - **FOAM BLANKET**
 - **COMBINATION**



PERFORMANCE DATA FOR APCD'S

PERFORMANCE DATA FOR FUME SUPPRESSANTS

CONDITION	CONCENTRATION (MG/DSCM)	PERCENT (%) REDUCTION
WITHOUT	0.921	--
FOAM BLANKET	0.005	99.5
COMBINATION	0.002	99.8

EMERGING TECHNOLOGY

BACKGROUND

- **DRIVEN BY STANDARDS PROMULGATED IN CA (2/88)**
- **THE MOST STRINGENT REQUIREMENTS FOR LARGE HARD PLATERS HAVE NOT BEEN ACHIEVED WITH CONTROL TECHNOLOGIES PREVIOUSLY DESCRIBED**
- **STANDARDS ARE TECHNOLOGY FORCING**

CURRENT SITUATION

- **VENDORS ARE DESIGNING NEW TECHNOLOGIES OR MODIFYING EXISTING TECHNOLOGIES IN AN ATTEMPT TO MEET THE CALIFORNIA STANDARDS**
- **TWO BASIC CONTROL TECHNOLOGIES ARE SURFACING**
 - **COMPOSITE MESH-PAD MIST ELIMINATOR**
 - **FIBER-BED MIST ELIMINATOR**

EPA RESPONSE

- **TRACK THE INSTALLATION AND TESTING OF ANY EMERGING TECHNOLOGY IN CALIFORNIA**
- **CONDUCT EMISSION TESTS THIS WINTER TO CHARACTERIZE PERFORMANCE OF TWO CONTROL DEVICES**
 - **EXTENDED PACKED-BED SCRUBBER FOLLOWED BY COMPOSITE MESH-PAD**
 - **SERIES OF THREE MESH-PADS (COARSE, COMPOSITE, COARSE)**
- **EXPECTATION IS THAT THESE UNITS WILL BE MORE EFFECTIVE THAN CONVENTIONAL TECHNIQUES**

Regulatory Alternatives

Nationwide Impacts

Project Schedule

REGULATORY ALTERNATIVES

Source Subcategory	Model Plant Sizes		
	Large	Medium	Small
DECORATIVE	←---Fume Suppressant---→ or ←Trichrome Plating Solution→		
ANODIZING	←---Fume Suppressant---→		

REGULATORY ALTERNATIVES

HARD CHROME ELECTROPLATING

Regulatory Alternatives	Model Plant Sizes		
	Large	Medium	Small
I	-----Emerging Technology-----		
II	--Emerging Technology--		Packed-bed Scrubber
III (FLOOR)	-----Packed-bed Scrubber-----		
IV	Packed-bed Scrubber	Packed-bed Scrubber	Chevron-blade Mist Eliminator
V	--Chevron-blade Mist Eliminator--		

Emerging Technology--Advanced mesh-pad mist eliminator

DECORATIVE AND ANODIZING

NATIONWIDE IMPACTS

	DECORATIVE	ANODIZING
•Control tech.	Fume Suppressant	Fume Suppressant
•Demonstrated	yes	yes
•% Using	80	30
•Emission reduction, Mg/yr *	9.7	3.6
•Annualized costs, 10 ⁶ \$ *	Credit to 1.2	Credit to 0.65
•Cost effectiveness, 10 ³ \$/Mg	Credit to 125	Credit to 184
•Economic impacts	No adverse	No adverse

*--Emission reduction and annualized costs are beyond baseline

HARD CHROME ELECTROPLATING

NATIONWIDE IMPACTS

	RA III	RAII	RA I
•Control tech.*	PBS (L,M,S)	ET/PBS (L,M/S)	ET (L,M,S)
•Demonstrated	yes	no	no
•% Using	40	<1/40	<1
•Emission reduction, Mg/yr **	140.8	143.7	144.2
•Annualized costs, 10 ⁶ \$ **	12	19	22
•Cost effectiveness avg., 10 ³ \$/Mg	90	130	150
•Incre. CE, 10 ⁶ \$/Mg	0.56	2.4	6.0
•Economic impacts			
-Electroplating cost increase, %	1-28	2-28	2-32
-Product price increase	-----GENERALLY <1 % -----		
-Business closures	----- 2% or LESS -----		

* --PBS--Packed-bed scrubber

--ET---Emerging technology

--L=Large, M=Medium, S=Small model plant sizes

**--Emission reduction and annualized costs are beyond baseline

HARD CHROME ELECTROPLATING

NATIONWIDE IMPACTS

	RA III	RAIV	RA V
•Control tech.*	PBS (L,M,S)	PBS/CBME (L,M/S)	CBME (L,M,S)
•Demonstrated	yes	yes	yes
•% Using	40	40/30	30
•Emission reduction, Mg/yr**	140.8	139.0	127.2
•Annualized costs, 10 ⁶ \$**	12	11	5
•Cost effectiveness avg., 10 ³ \$/Mg	90	80	40
•Incre. CE, 10 ⁶ \$/Mg	0.56	0.51	0.04
•Economic impacts			
-Electroplating cost increase, %	1-28	1-16	1-16
-Product price increase	-----GENERALLY <1 % -----		
-Business closures	-----LESS THAN 2%-----		

* --PBS--Packed-bed scrubber

--CBME-Chevron-blade mist eliminator

--L=Large, M=Medium, S=Small model plant sizes

**--Emission reduction and annualized costs are beyond baseline

PROJECT SCHEDULE

Complete Testing for Emerging Tech.	03/91
PROPOSAL	02/92
PROMULGATION	02/93

NATIONAL ASSOCIATION OF METAL FINISHERS
NAMF

PRESENTATION OUTLINE
NAPCTAC

January 30, 1991

- NAMF is the trade association representing over 900 members in the Surface Finishing Industry.
- NAMF and its Southern California affiliate have been involved in chrome air regulations over the past 4 years and expended significant resources on source and control technology.
- Source reduction is the preferable method for air emission control.
- Initial reviews of the draft chrome electroplating indicate that source reduction techniques predominate and will result in realistic controls and emission reductions
- The draft document indicates that this is an industry that has implemented a significant level of air emission control.
- The association intends to continue the cooperation on development of a workable chrome electroplating standard.
- The association will be providing additional data on use of fume suppressants in small scale hard chrome plating.

NATIONAL ASSOCIATION OF METAL FINISHERS PRESENTATION OUTLINE OF M. DEAN HIGH NAPCTAC MEETING - 1/30/91

OBJECTIVE

- Relate experience with fume suppressants in SCAQMD

BACKGROUND

- 2/88 CARB adopted 3 tier control measure for chromium plating and analyzing operations
- 6/88 SCAQMD adopted Rule 1169 which copied CARB
- 6/89 SCAQMD agreed to certify specific fume suppressants if source tests were done under their supervisions

SOURCE TESTS - HARD CHROME PLATING

- 10/89 M & T Chemical Fumetrol 101 12 1-hour tests
- 11/89 O M I International Foam Lok-L 12 1-hour tests
- Two tests each at 800, 1600, & 2400 A w/o suppressant
- Two tests each at 800, 1600, & 2400 A w suppressant

RESULTS

- M & T 97.2% reduction
- O M I 98.6% reduction

CONCLUSION

- Fume suppressants are in use by small hard chrome platers

U.S.E.P.A.
NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE

JANUARY 30

NESHAP BASED ON MACT-CHROMIUM ELECTROPLATING

G.C. PEDERSEN, PRESIDENT, KIMRE, INC.
W.M. SCHOTT, SALES & MARKETING MGR., KIMRE, INC.

Kimre, Inc.

P.O. BOX 570846 • PERRINE, FLORIDA 33257-0846 • (305) 233-4249
• TELEX: 62875724 KIMRE MIA • CABLE ADDRESS: KIMRE MIA
TELEFAX: 305-233-8687

Chrome Control Technology using Multi Stage Aerosol Removal Systems

Multi stage aerosol removal systems have been developed for a variety of uses. The systems are site-specific; they can deal with a wide range of particle size including submicron. These systems are particularly useful in chrome emission control.

The attached drawing, TI-39B, shows a generalized system configured for chrome. Such a three-stage system can achieve .006 mg/amp-hr or 99.8% overall removal. Systems guaranteed to meet those limits are being supplied.

The guarantee is subject to four conditions:

1. Operating conditions to be no worse than those specified (for example, 10 mg/amp-hr chrome ⁺⁶ loading).
2. Prior approval of the vessel design by the mesh pad manufacturer.
3. Equipment be built as approved and operated as designed.
4. Performances are based on ambient conditions.

The first stage is a composite mist eliminator pad designed for removal of droplets three microns and larger; this is expected to be the majority of the chromic acid droplets. This pad is designed for high removal efficiency and high liquid handling capacity.

The second stage is a composite coalescer pad. It is designed to capture 99% of all droplets one micron and larger. This high removal efficiency is due to several factors:

1. More layers of finer styles of material are used.
2. The second stage is operated at a higher velocity than the first stage to increase interception and impaction of droplets.
3. The flooded condition of the finer styles results in coalescing and removal of extremely fine droplets.

In the second stage although the finer styles of media do most of the removal, coarser styles are used to protect the finer styles from pluggage and to provide mechanical support.

The third stage is a simple entrainment separator to capture and remove any droplets coalesced and re-entrained off the downstream side of the second stage.

As can be seen from the above explanation the function of each stage is different. Each function, however, is necessary for the system to work:

1. Removal of large particles; handling of heavy liquid loads.
2. Coalescing of small particles.
3. Removal of re-entrained particles.

The use of composite mesh pads of differing material styles allows each stage to be tailored for appropriate liquid handling, particle removal efficiency, and pressure drop. Although a single pad could be built to achieve the desired removal, it would be suboptimal on other qualities.

Another benefit of the multi stage system is protection against failure. Should by-passing around one stage occur, the other two stages will still provide considerable protection.

Two other design issues need to be addressed --- maintenance and by-pass of chromate-laden air around the pads.

Clearly, the scrubber surrounding the above system should allow for convenient inspection and cleaning. Cross-flow systems are generally easier to maintain than vertical ones. Mounting the pads in cartridges makes removal and insertion simpler. Depending on site conditions continuous or intermittent spray is needed to reduce the possibility of pluggage. This also prevents the chemical attack of chromic acid residue on materials of construction.

Because of the high removal performance needed, by-pass is a critical issue. The uniform structure of the mesh pads prevents gas "channeling" through the pads. Three other potential avenues for by-pass must be closed off, though:

1. The fit between the pads and the cartridge.
2. The fit between the cartridge and the housing.
3. The drain for captured liquid.

Various techniques are available to solve the above problems. Obviously they need to be considered early in the equipment design process. Use of this technology is based on close cooperation between the mesh pad vendor, the OEM and the user from the early stages on.

January 29, 1991

REGULATORY ALTERNATIVES

(with floor indicated)

HARD CHROME ELECTROPLATING

Model Plant Sizes

Regulatory Alternatives	Large	Medium	Small
I	←Emerging Technology→		
II	←Emerging Technology→		Packed-bed Scrubber
III (FLOOR)	←Packed-bed Scrubber→		
IV	Packed-bed Scrubber	Packed-bed Scrubber	Chevron-blade Mist Eliminator
V	←Chevron-blade Mist Eliminator→		

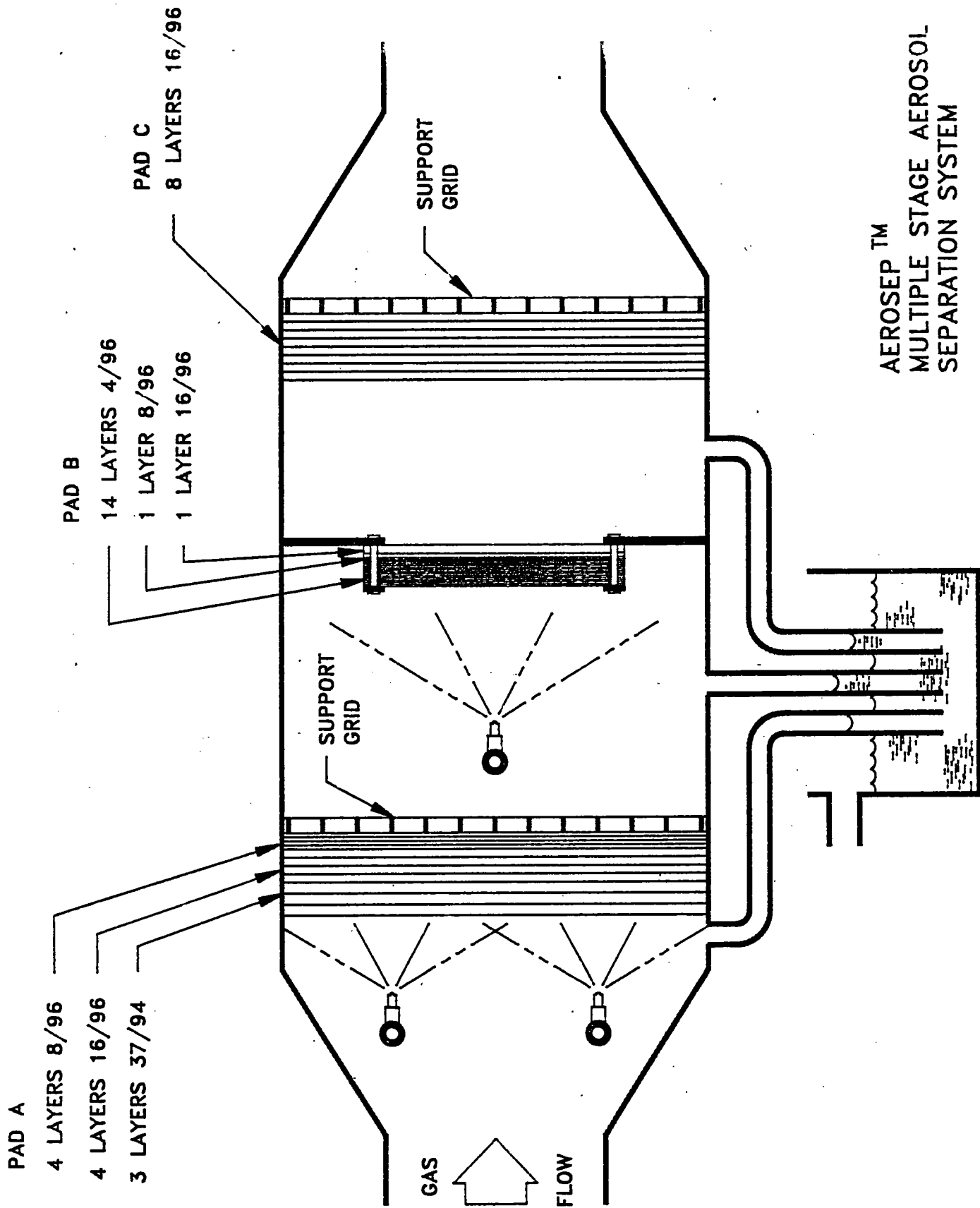
Emerging Technology—Advanced mesh-pad mist eliminator

EMERGING TECHNOLOGIES

EMERGING IN CHROME EMISSIONS CONTROL

GENERALLY AVAILABLE CONTROL TECHNOLOGY

- OIL MIST
- INCINERATION
- SEMICONDUCTOR MANUFACTURE



KIMRE, INC. PERRINE, FL

TI-39B

CONDITIONS

- OPERATING CONDITIONS NOT WORSE THAN SPECIFIED
- PRIOR APPROVAL OF VESSEL DESIGN BY MESH PAD MANUFACTURER
- EQUIPMENT TO BE BUILT AS SPECIFIED AND APPROVED

MULTISTAGE AEROSOL REMOVAL SYSTEM

STAGE 1: REMOVES LARGE PARTICLES
AND LIQUIDS

STAGE 2: COALESCES AND REMOVES
SMALL PARTICLES

STAGE 3: REMOVES RE-ENTRAINED
PARTICLES

DESIGN ISSUES

PARTICLE SIZE DISTRIBUTION

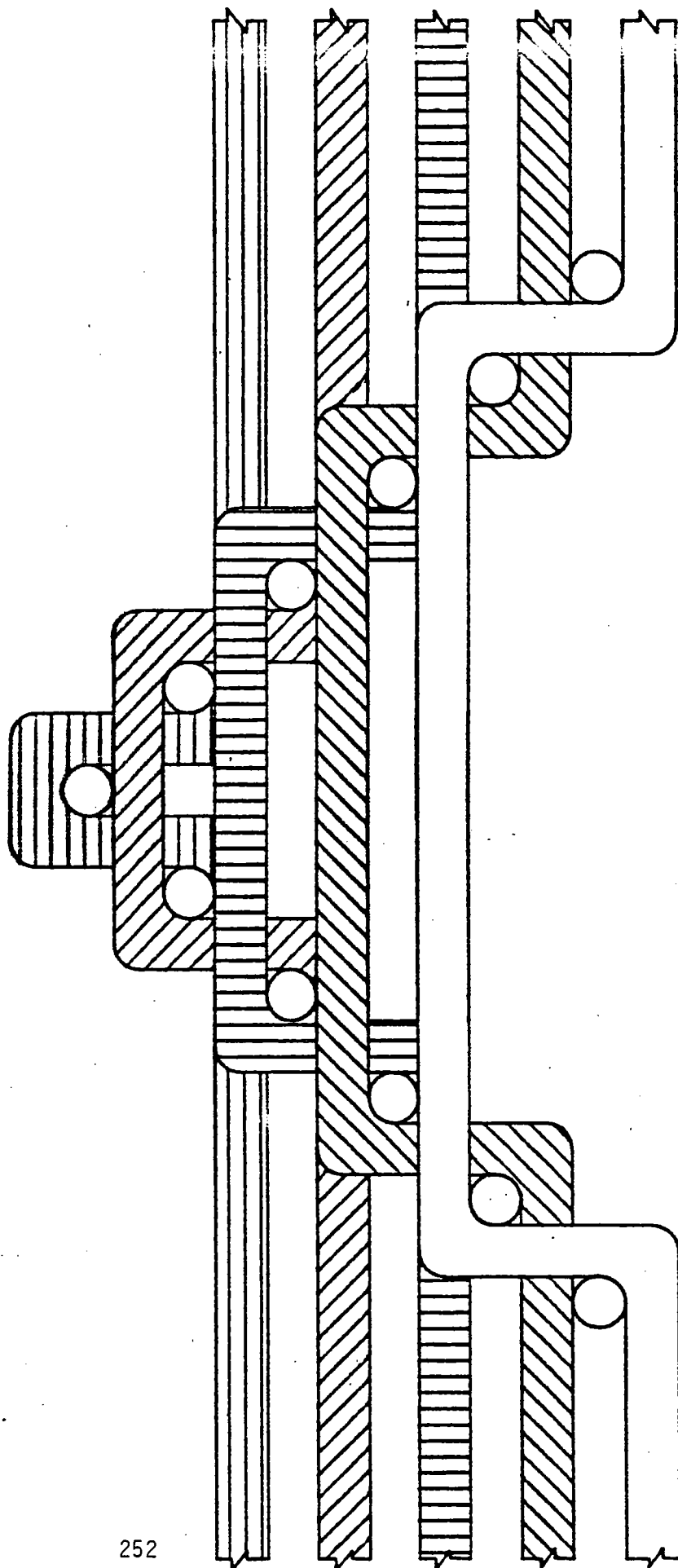
MAINTENANCE AND ACCESS

BY-PASS

- AROUND PAD
- AROUND CARTRIDGE
- THROUGH DRAIN LINES

Figure
2

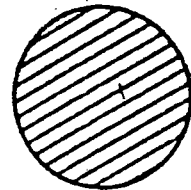
MONOFILAMENT STRUCTURE



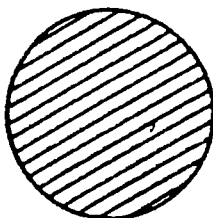
KIMRE B-GON™ FIBERS

•

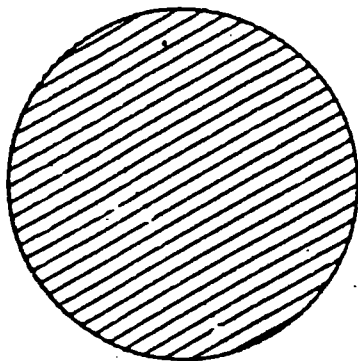
2 MIL 4 MIL 8 MIL 16 MIL



32 MIL



37 MIL



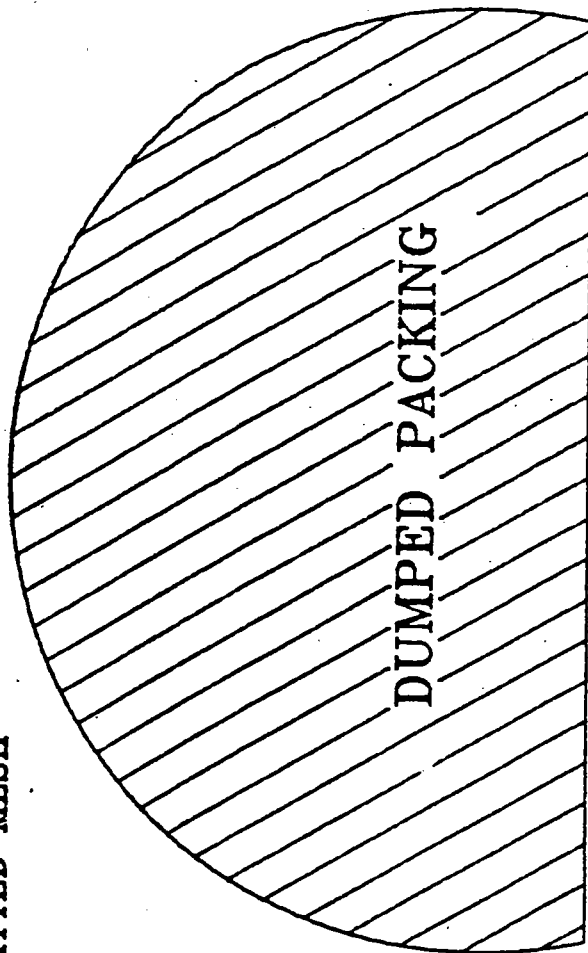
62 MIL

•

1 MIL
BRINKS H.P.



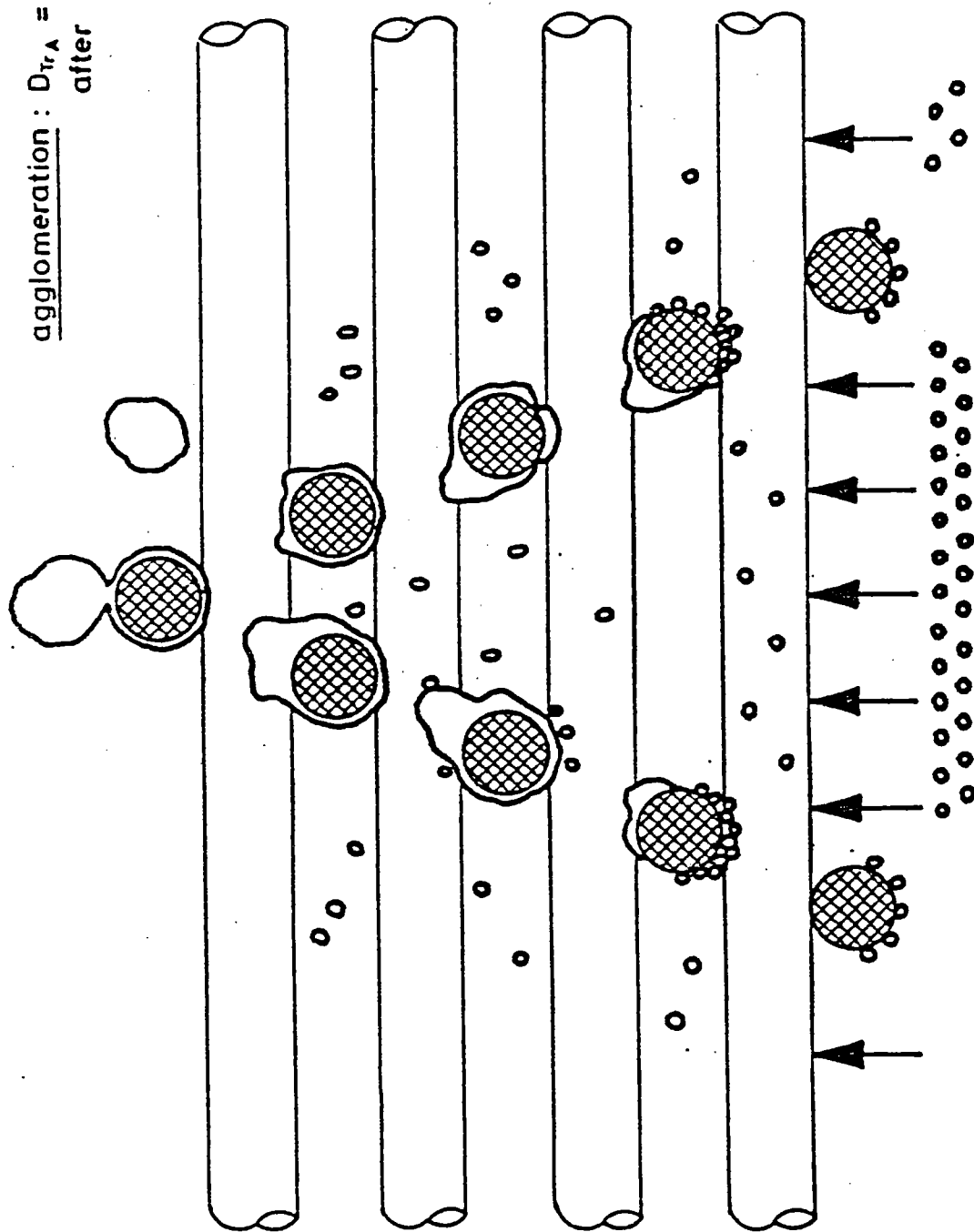
11 MIL
KNITTED MESH

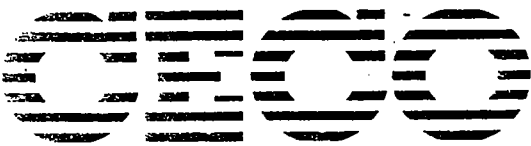


DUMPED PACKING

FIGURE 5:
FIBER SIZE
COMPARISON

agglomeration : $D_{trA} = 0,8 \div 1,0 \mu \rightarrow D_{trE} = 10 \div 12$
after N layers





FILTERS, INC.

1013 CONSHOHOCKEN ROAD • P.O. BOX 683 • CONSHOHOCKEN, PA 19428-0683 (215) 825-8585, FAX #(215) 825-3108

January 16, 1991

Mr. Al Vervaert
MD-13
U.S. EPA
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

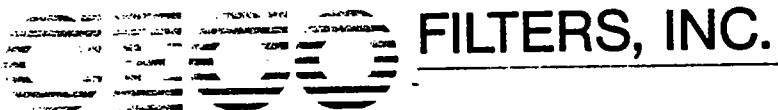
Reference: Comments on Status Briefing - Chromium
Electroplating Chromic Acid Anodizing NESHAP

Dear Mr. Vervaert:

Thank you for spending a few moments of your time to discuss with me some of my company's comments concerning the subject report. CECO Filters, Inc. designs, engineers, manufactures and sells fiber bed mist eliminator filters. These devices were discussed in the referenced report. This letter serves to summarize our thoughts with regard to the discussion relating to fiber bed filters.

Fiber bed filter technology was developed many years ago to take advantage of the Brownian motion of very small particles for particle collection and recovery purposes. Early uses of fiber bed devices, sometimes called deep bed filters or candle filters, included the recovery of radioactive particles. Early commercial use of these devices centered about the collection of sulfuric acid mist and present uses cover a wide variety of applications. Early fiber bed units operated at relatively low superficial velocities. This is due to the fact that the efficiency of fine particle collection by Brownian motion, diffusion, is directly related to the amount of time a particle is within the region of a collecting body. The longer the residence time, the more likely an effective impact between the fine particle and a collecting surface.

This concept is directly opposite to collection of particles by inertial impaction. This collection mechanism depends on using the momentum of a particle. The basic concept is that a particle with enough momentum will continue along a given velocity gradient and break away from a gas streamline as the gas flows about an object, in this case a



Mr. Al Vervaert
U.S. EPA

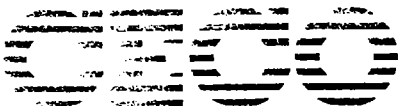
January 16, 1991
Page 2

collecting surface. Because the particle is directed out of the main flow of the gas stream, it can impact with the collecting body and be captured. With impaction, the higher the momentum the better the collection. However, using the impaction mechanism to collect fine particles is difficult. The reason for this is because the momentum of a fine particle is very small in comparison to that of large particles. For example, the mass of a 0.5 micron particle is 8 times less than that of a 1 micron particle. Therefore, to achieve the same momentum for the small particle as the larger particle, the gas velocity must be very high (holding particle density constant).

Fiber bed filter units also collect particles through the impaction mechanism. This mechanism is quite effective for particles greater than 3 microns, but occurs, to some extent, for particles 1 micron and smaller. The collection efficiency, however, at the smaller particle size is not very high. When it was recognized that fiber bed filters could be used as impaction devices they were placed into service to replace mesh pads. Usually collection efficiency increased over that of the mesh pad. Because the fiber diameter of a fiber bed filter is typically less than 35 microns, it is, at least in theory, always a better collector of particles than even the finest mesh pad, where 2 mils, 50 microns, is the minimum collector size. This is due to the impaction coefficient being inversely proportional to the fiber diameter. By varying the packing density of a fiber bed filter a relatively low pressure drop can be achieved. Because of this, fiber bed filters have begun to compete with, and in some cases replace, mesh type pads when high efficiency, for particles less than 3 microns, at reasonably low pressure drop is required.

Pages 33 through 35 of the referenced report discuss multi mesh pads and fiber bed filters. It appears that the writers reached the conclusion that fiber bed filter technology is unproven as it applies to chrome systems and that mesh pad systems may be more advantageous. I'd like to discuss our view of this conclusion.

CECO Filters is familiar with fiber bed filter applications and can address their use, either as impaction devices or as diffusion devices. CECO has installed three



FILTERS, INC.

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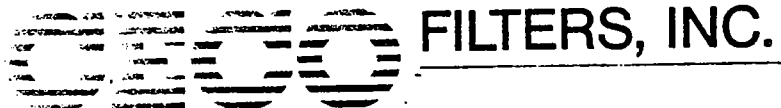
commercial chromic acid filter systems. The flow rates vary from 1,000 ACFM to over 60,000 ACFM and each is a diffusion type system. Two of the units have been in continuous service for over two years. The pressure drop across the filters, which is a measure of plugging, has remained virtually constant. Each of these systems is preceded by a low energy scrubber. The particle size distribution of one of the systems is skewed toward particles less than 1 micron.

The particle size distribution of chromic acid entrained in an electroplating or anodizing emission may be dependent on how the particle was formed. If the bulk of particles is less than 1 micron, we believe that fiber bed filters utilizing the Brownian motion, diffusion, mechanism will be the most economical and least environmental damaging choice. The units will remove very fine particles at reasonable pressure drops without the need for continuous liquid irrigation. The savings gained on irrigation liquid disposal alone may be enough to justify the use of fiber bed filters.

CECO Filters has recently patented two innovative designs which help improve the utility of fiber bed filters. The first is our N-SERT® and X-SERT® prefilters. These units protect the upstream side of a fiber bed filter from plugging. In effect, the devices serve as a removable filter surface. If pluggage occurs and the filter is unable to be cleaned by irrigation, the prefilter can be changed and the pressure drop restored to nearly its initial value.

Our other patented device is the CECO multi-bed filter - typically configured as a double or triple filter. The design of this device consists of two or more fiber bed filters nested in such a manner to achieve parallel flow. This innovation permits the user to maximize superficial surface area in the same space. For example, an ordinary fiber bed filter design may require as many as 19 individual units to service 30,000 ACFM. With our double filter units, only 12 are required. This permits the vessel diameter to be decreased from about 11'-6" to 9'-6". The capital cost is much less.

If we find that the particle size distribution entrained in the gas stream is relatively coarse, mainly particles over 1 micron, we can use impaction fiber bed filters. These



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devices are quite effective for the collection of larger sized particles. For 30,000 ACFM only 3 or 4 units would be required. The vessel diameter would be 6'. Capital cost is very competitive to the multipad design. The impaction fiber bed filters can be protected with our prefilters and they can be irrigated.

Even though our units are field proven in chromic acid service, we recognize that independent authorities may wish to gather their own data and information. We are willing to work with you to establish a test program, at a site selected by you, designed to explore the performance of our diffusion and impaction fiber bed units. We have a pilot plant available for the test program.

Please feel free to call or write us for more information. I have enclosed some of our brochures for your review. Please be kind enough to submit this letter as our formal comment on the report. Thank you.

Very truly yours,

CECO Filters, Inc.

Steven I. Taub

Steven I. Taub,
President

SIT/al

Enclosures

(ENCLOSURES NOT INCLUDED IN MINUTES OF MEETING)

DISCUSSION

Following the EPA presentations and each of the industry presentations, Mr. James Weigold, ESD/EPA, opened the floor to questions and comments from the NAPCTAC members. The ensuing discussion and responses are summarized in the following paragraphs.

Following the EPA presentation, Ms. Vivian McIntire of the NAPCTAC Committee asked if there was a better way to classify the model plants other than by the number of tanks, such as by the amperage or surface area of the tanks. Mr. Andy Smith, ISB/EPA, replied that the model plant sizes were actually based on ampere-hours per year.

Ms. McIntire noticed that charts from the presentation showed that hard and decorative chromium electroplaters used some of the same control equipment. She asked if hard and decorative chromium electroplating could be done in the same tank. Mr. Smith said that EPA had not seen this done. Ms. McIntire asked if hard chromium electroplaters could use fume suppressants. Mr. Smith replied that hard chromium electroplaters typically do not use fume suppressants because their use can cause defects in the plated parts or hydrogen explosions; however, the regulation would not bar anyone from using fume suppressants should they so desire.

Ms. McIntire wondered why one of the chevron-blade mist eliminators tested showed an efficiency of 98.4 percent while the efficiency of the packed-bed scrubber (a higher control level) ranged from 96 to 97 percent. Mr. Smith replied that these efficiencies are based on percent reduction which is not a good indicator of performance because the control devices tested achieve a constant outlet concentration regardless of the inlet concentration.

Ms. McIntire asked if the small difference in performance (shown by the test data) between using washdown and no washdown for packed-bed scrubbers is significant and reproducible. Mr. Smith replied that it was a significant difference and reproducible. Mr. William O'Sullivan of the NAPCTAC Committee asked if EPA will require washdown for packed-bed scrubbers. Mr. Smith replied that EPA will carefully consider this.

Mr. O'Sullivan asked if EPA has considered requiring the use of a wetting agent alone. Mr. Smith replied that although a wetting agent alone has not been tested, EPA will consider that option. Mr. O'Sullivan was concerned that because wetting agents are not visible like foam blankets or add-on pollution control devices, EPA would have difficulty enforcing the use of wetting agents. Mr. Smith replied that inspectors could measure the

surface tension of the bath using a stalagmometer to determine if wetting agents were applied at an appropriate rate. Mr. O'Sullivan asked if a stalagmometer was easy for an inspector to obtain and use. Mr. Smith replied that it was.

Dr. John Pinkerton of the NAPCTAC Committee asked if the cost effectiveness by the size of shop was or will be considered in developing and selecting control options for hard chromium electroplaters. Mr. Lalit Banker, SDB/EPA, replied that cost effectiveness by shop size was part of the basis for creating control options (Alternatives 2 and 4) that required less-stringent control for small model plants.

Dr. Pinkerton asked if there is any advantage to early reduction because of the current high control levels in the industry. Mr. Weigold replied that industry may want to consider this.

Mr. Paul Arbesman of the NAPCTAC Committee commented that he was interested to see that EPA considered pollution prevention as a control option and that pollution prevention options should be considered in other projects also. Mr. Arbesman added that a consistent rationale should be developed for determining major or area source classifications based on lesser quantity cutoffs.

Mr. Arbesman asked why the overall emission reduction was so high when the existing industry baseline incorporates such high levels of control. Mr. Al Vervaert, ISB/EPA, replied that the baseline level includes a significant number of uncontrolled facilities, and that the baseline control level assigned to each control device was lower to account for improper maintenance of these devices.

Mr. Arbesman asked if the costs associated with the emerging technology alternatives were calculated assuming that the 40 percent of hard chromium electroplaters currently using packed-bed scrubbers would continue to operate those devices. Mr. Banker replied that the costs associated with emerging technology alternatives were calculated assuming that the packed-bed scrubbers currently in operation would be replaced.

Dr. Patrick Atkins of the NAPCTAC Committee asked if decorative chromium electroplaters and chromic acid anodizers could use other controls instead of fume suppressants to comply with the regulation because bath additions are not always desirable. Mr. Banker replied that the type of control will not be specified in the regulation, so they may use any control to meet the emission limit. Dr. Atkins asked if the life of the bath is affected by fume suppressant additions. Mr. Smith replied that based on data from numerous facilities and conversations with vendors, fume suppressants do not affect bath life.

Mr. Charles Collins inquired about uncertainties in the test method that was used and asked if the chromium compound measured was chromic acid (i.e., hexavalent chromium) or total chromium. Mr. Vervaert replied that there is a problem with testing for hexavalent chromium in other environments, such as cooling towers and combustion sources, but not in this case.

Mr. Ralph Hise commented that he was pleased to see EPA had looked ahead at emerging technologies in the field and suggested that EPA continue to do this for other NESHAP. Mr. Weigold replied that EPA does try to investigate emerging technologies, but the problem is defining when these technologies should be considered demonstrated.

Mr. Donald Arkell of the NAPCTAC Committee asked if the annualized cost estimates for the control options accounted for operation and maintenance (O&M) costs only or if amortization was included. Mr. Smith replied that the annualized cost estimates did include capital recovery costs, as well as O&M costs. Mr. Arkell asked why there were differences in the amortization costs for packed-bed scrubbers and mesh-pad mist eliminators. Ms. Robin Barker, Midwest Research Institute, replied that there is a difference in the useful lives of these devices.

Dr. Pinkerton asked if the regulation would be based on outlet concentration or specified controls. Mr. Smith replied that the regulation will be based on outlet concentration and not specified controls. Mr. Arbesman asked if the outlet concentration varied with different inlet concentrations. Mr. Smith replied that it does not.

Ms. McIntire commented that because industry could elect to use any type of control device to meet the emission limit, no burden should be placed on enforcement personnel to determine if a particular control device was appropriate. Mr. O'Sullivan suggested that EPA consider certification for alternative controls since the number of sources is so large.

Mr. William Sonntag of the National Association of Metal Finishers (NAMF) made the following comments on the preceding discussions before his presentation: (1) hard and decorative chromium electroplating are never performed in the same tank; (2) fume suppressants do not affect the life of the plating bath; and (3) the explosion hazard associated with the use of fume suppressants by hard chromium electroplaters can be eliminated through changes in process techniques (i.e., moving any spark source further from the bath surface).

Following the presentation given by Mr. Sonntag and Mr. Dean High of Pacific Environmental Services, Mr. Hise inquired about the life of a foam blanket. Mr. High replied that frequent additions to the bath are necessary due to drag out, which occurs

when parts are removed from the bath. Dragout is more of a problem with decorative chromium electroplaters than hard chromium electroplaters because decorative chromium electroplaters have shorter plating times and, thus, parts are added and removed more frequently. Also, the foam may be sucked into the exhaust hood if the freeboard is too small.

Mr. O'Sullivan asked if the testing referred to in the presentation was performed for chromic acid (i.e., hexavalent chromium) only or total chromium. Mr. High replied that testing was performed for both chromic acid (hexavalent chromium) and total chromium. Mr. O'Sullivan asked if the hexavalent chromium concentration matched the total chromium concentration. Mr. High replied that the hexavalent chromium concentration varied from 50 to 100 percent of the total chromium concentration, but was typically 80 percent.

Following the presentation given by Mr. Chris Pederson and Mr. William Schott of Kimre, Inc., Mr. Arkell inquired about the nominal flow rate of the device. Mr. Pederson and Mr. Schott replied that the overall flow rate was 6 to 10 feet per second with a flow rate of 400 feet per minute across the first and third pads and a flow rate of 600 feet per minute across the second pad.

Mr. Hise inquired about the cost of the device. Mr. Pederson indicated that the total cost of the device would be available through the scrubber manufacturers, but that the cost of the mesh-pad portion increases the cost of the device by approximately 30 percent over the cost of the standard packed-bed scrubber. Mr. Pederson added that the device reduces emissions 10 to 15 times below what the standard packed-bed scrubber achieves.

X. NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)
BASED ON MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT)

EPA PRESENTATION

Mr. Robert E. Rosensteel
Emission Standards Division
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Research Triangle Park, NC 27711

SUMMARY

EPA reported to the National Air Pollution Control Techniques Advisory Committee (NAPCTAC) on the development of National Emission Standards for Hazardous Air Pollutants (NESHAP) for hazardous organics. The Hazardous Organic NESHAP (HON), being developed under Group I Standards of Title III of the Clean Air Act Amendments, will regulate the Synthetic Organic Chemical Manufacturing Industry (SOCMI).

The presentation covered the significance and scope of HON, HON emission sources, candidate technologies being considered to determine Maximum Achievable Control Technologies (MACT), impacts and economic analyses, regulatory options development, interactions with external groups, and the project schedule. This section summarizes the presentation, a copy of which is included as Attachment 1.

HON contributes significantly to the Title III requirement to set standards for 40 or more source categories or subcategories within 2 years of enactment of the Clean Air Act Amendments (CAAA), and regulates a large portion of SOCMI, including as many as 110 of the 189 Hazardous Air Pollutants (HAPs) listed in the CAAA. A SOCMI production process is regulated under the HON if

it produces or uses one or more of the approximately 110 SOCMIs HAPs included in the CAAA. HON includes 400 subcategories and affects approximately 1000 individual process units as estimated by our analysis at this time.

HON emission sources include equipment leaks, process vents, storage vessels, transfer operations; and wastewater operations. A determination of MACT will be made for each of these emission sources. This determination will include selection of control techniques (including pollution prevention options) and applicability criteria to determine what classes, types, and sizes of SOCMIs sources are required to apply control. Control techniques have already been identified based on past and current rulemaking efforts. These controls were selected to result in maximum emission reduction for each of the five emission source types. Applicability criteria will be the focus of future regulatory options analysis. Control and pollution prevention techniques for each source type are listed in Table 1 of Attachment 1.

The impacts analysis for the HON is a four-step approach that includes characterization of the industry, development of model emission sources unique to each source type, assignment of models to each production process, and estimation of emissions, emission reductions, and control costs. Economic analyses will be conducted to determine response to regulations and the need for additional analyses for a subset of chemicals. Cumulative cost, chemical cost increases, and detailed and market analysis of selected subsets will be included in the economic analyses.

Regulatory options will be developed for four of the emission source types. Options for equipment leaks will not be evaluated in the HON. Regulatory options will comprise both control technologies and applicability criteria and will be at least as stringent as the MACT floors. Applicability criteria will

include measurable characteristics of the emission source and chemical properties as shown in Table 2. The impacts considered for regulatory options include baseline emissions, MACT floor, HAP and VOC emission reduction, incremental emission reduction, number and percent of emission sources controlled, annualized and incremental control costs, average and incremental cost effectiveness, and chemical cost increases. Other environmental and energy impacts, including barrels of oil equivalent, water impacts, and secondary air emission impacts, will also be estimated.

EPA has met or made contact with several external groups in the process of developing the HON standards. These groups include the Chemical Manufacturers Association (CMA), the Synthetic Organic Chemical Manufacturers Association (SOCMA), the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), the National Association of Manufacturers (NAM), and the National Resources Defense Council (NRDC). Additional contact with these and other groups is expected. The current schedule calls for HON standards to be proposed on November 22, 1991, and promulgated on November 15, 1992.

DISCUSSION

Following the presentation, Committee member Ms. Deborah Sheiman (NRDC) asked how cutoffs for the different source categories will be determined and how they will compare with NSPS cutoffs. Mr. Rosensteel, EPA, replied that different cutoffs incorporating various degrees of stringency will be developed, based on applicability criteria. For example, size and vapor pressure will be considered for storage vessels, and stream flow and concentration will be considered for process vents. NSPS cutoffs will be considered as an aid in developing the MACT floor, but are not expected to be adopted as cutoffs for these rules.

Ms. Sheiman inquired what standards will be required for emission sources below the cutoff. Mr. Rosensteel responded that these sources will have to maintain stream characteristics below the cutoff level. Ms. Sheiman argued for development of control requirements for sources both above and below the cutoff, and indicated that sources below the cutoff should also be required to reduce emissions. Mr. Rosensteel replied that these sources do have to maintain emissions below the cutoff level.

While she acknowledged the limited time available to gather information, Ms. Sheiman indicated that EPA should gather more source-specific data in order to develop more robust standards. Mr. Rosensteel indicated that it was impractical to gather and analyze in-depth data for the entire industry. Mr. Jim Weigold, EPA, added that previous efforts to regulate this industry had been thwarted by a cycle of continual analysis and that disciplined action was necessary to implement controls. Mr. Weigold added that EPA would use any information provided.

Committee member Ralph Hise (Advanced Technologies Management) questioned whether it was practical to develop standards for 400 subcategories in 2 years, considering that the law only calls for the development of 40. Mr. Rosensteel replied that similarities among all the processes and control techniques makes it practical to develop the standards simultaneously. Mr. Hise questioned whether 1000 process units or 1000 chemicals were being regulated, and inquired about the total number of major area sources. Mr. Rosensteel responded that 1000 process units is our current estimate, and that the number of major and minor sources has not yet been analyzed. He indicated that there are 6000 process units in the chemical and allied industries [Standard Industrial Classification (SIC) Code 28] and that the SOCM I is a subset of SIC 28. Mr. Rosensteel added that our estimates show the SOCM I accounting for 1000 process units with a

judgement that the HON would not affect more than 2000 process units.

Committee member Vivian McIntire (Eastman Chemicals Company) complimented EPA on their pollution prevention approach, encouraged EPA to develop flexible standards, and indicated the need to consider how compliance will be demonstrated, as it will be hard to quantify the effects of process changes. She also inquired whether facilities that recycle and recover chemicals would be subject to the HON. Mr. Rosensteel replied that these facilities probably would be so regulated. Mr. Rosensteel added that previous applicability decisions on the distillation NSPS considered recovery facilities to be subject to the rule if they produce a SOCOMI chemical for sale.

Ms. McIntire indicated that most wastewater treatment plants have mixtures of potentially regulated and non-regulated chemicals and questioned whether such mixtures would be controlled under the HON. Ms. McIntire indicated that further description would be needed, as many facilities combine many streams from many types of processes. Ms. Penny Lassiter, EPA, replied that determinations of control requirements would be made at the point of generation of the stream. However, for treatment, streams could be combined. Ms. Lassiter added that streams would be considered at the point of generation since a few streams represent a large percentage of the emission potential, and it is more efficient to control them before mixing.

Ms. McIntire then asked how the HON standards would interface with those in the Resource Conservation and Recovery Act (RCRA). Ms. Susan Wyatt, EPA, replied that HON and RCRA regulations complement each other, as wastewater tanks are not covered under RCRA. Ms. McIntire inquired which rule would cover sewers. Ms. Wyatt replied that HON would regulate emissions from sewers and sumps. Ms. Wyatt added that, since EPA's Emission Standard

Division is developing both the RCRA and the HON, the two rulemakings will be well coordinated.

Ms. McIntire questioned why control efficiency for equipment leaks was set at 85-88 percent rather than 88-90 percent, and asked whether credits for 90 percent early reduction would be given. Mr. Rosensteel replied that the percentages were preliminary numbers that may be changed and would in any case depend on site-specific process characteristics. Ms. McIntire also inquired whether fugitive emissions could be considered for the 90 percent early reduction credit. Mr. Weigold replied that the amount of credit for fugitive emissions was under debate. Ms. McIntire emphasized the importance of industry options and flexible controls for MACT, and advocated the allowance of alternatives to combustion control. Mr. Rosensteel responded that performance standards would be emphasized and could be met using any technology. Ms. McIntire commented that increased NO_x and CO emissions are likely effects of compliance if combustion is used. Mr. Weigold indicated that EPA would consider NO_x and CO emission levels from combustion devices. Mr. Weigold also mentioned that the relative worth of HAP emission reduction and NO_x/CO emission increase would need to be determined.

Committee member William O'Sullivan (New Jersey Department of Environmental Protection) commented that flares may not be as efficient as incinerators and that enclosed flares may perform better than open flares. Mr. Rosensteel replied that previous research defined flare operating conditions and showed that, when operated properly, both open and enclosed flares are efficient. Mr. O'Sullivan inquired whether carbon adsorbers were included. Mr. Rosensteel responded that, while not specifically listed in the handout, carbon adsorbers are a pollution prevention device that individual facility owners could consider using.

Mr. O'Sullivan commented that both vapor pressure and weight percent HAP concentration should be included as an applicability criteria for process vents in order to determine if condensation would work. Mr. Rosensteel indicated that vapor pressure is a variable that the individual source needs to obtain if considering condensation as a technique for reducing their organic emissions. It is not a variable that needs to be considered as applicability criteria for combustion. Individual facility owners can evaluate whether condensation is a practical alternative to combustion for their stream characteristics.

Ms. McIntire recommended moving the proposal date from November 22, in order to avoid conflict with the Thanksgiving holiday. Mr. Charles Collins (Wyoming Department of Environmental Quality) asked whether the standard precluded sending wastewater to public treatment facilities. Ms. Wyatt responded that if emissions were above the cutoff level, wastewater streams may need to be treated before being sent to public facilities.

Committee member Paul Arbesman (Allied-Signal, Inc.) emphasized the importance of adequate information to develop the rules, and inquired what the format of the standard would be, noting that simple concentration standards had been problematic. He also indicated that effluent guidelines on concentration levels were difficult to implement, especially considering water conservation efforts. Mr. Rosensteel replied that a number of applicability criteria cutoffs would be considered, including HAP weight percent and flow. (See Table 2 of Attachment 1.) Ms. Wyatt added that process vent units exceeding the cutoff would probably have to meet a percent control. Mr. Arbesman also inquired whether Appendix A of the HON overview paper (December 1990) corresponded to the 110 HAPs. Mr. Rosensteel responded that Appendix A included production of the 110 SOCMIs HAPs, as well as SOCMIs chemicals that use a HAP in their production.

Ms. McIntire inquired whether process vent batch operations would be regulated. Mr. Rosensteel replied that process vent emissions from batch operations would be exempt under HON, as they will be covered in another rulemaking effort. Committee member William Dennison (Dennison and Associates) commented that the equipment leaks part of the HON regulation should also specify pump seals and valve packing requirements. Mr. Rosensteel indicated that further specific requirements, including use of superior equipment, have been developed during the equipment leaks negotiated regulation. It was not possible to include all of these specifics on the handout.

**HAZARDOUS ORGANIC
NESHAP (HON)**

**NATIONAL AIR POLLUTION CONTROL TECHNIQUES
ADVISORY COMMITTEE**

JANUARY 30, 1991

OUTLINE

SIGNIFICANCE OF HON

SCOPE OF HON

HON EMISSION SOURCES

DETERMINATION OF MACT

IMPACTS ANALYSIS

ECONOMIC ANALYSIS

REGULATORY OPTIONS DEVELOPMENT

INTERACTIONS WITH EXTERNAL GROUPS

PROJECT SCHEDULE

SIGNIFICANCE OF HON

- **MEETS TITLE III REQUIREMENT TO SET STANDARDS FOR 40 OR MORE SOURCE CATEGORIES WITHIN 2 YEARS OF CLEAN AIR ACT AMENDMENT (CAAA) ENACTMENT**
- **REGULATES A LARGE PORTION OF SYNTHETIC ORGANIC CHEMICAL MANUFACTURING INDUSTRY (SOCMI) AND UP TO 110 OF THE 189 HAPs LISTED IN THE CAAA**
- **AN ESTIMATE BASED ON TRIS INDICATES THAT 6 TO 10 PERCENT OF HAP EMISSIONS FOR THESE 110 ORIGINATE FROM SOCMI**

SCOPE OF HON

- **A SOCM I PRODUCTION PROCESS IS INCLUDED IF IT:**
 - (1) PRODUCES (AS A PRODUCT, CO-PRODUCT, BY-PRODUCT, OR INTERMEDIATE) 1 OR MORE OF THE APPROXIMATELY 110 SOCM I HAPs INCLUDED IN THE CAA AMENDMENTS LIST OF 189 HAPs; OR**
 - (2) USES 1 OR MORE OF THE APPROXIMATELY 110 SOCM I HAPs AS A REACTANT OR RAW MATERIAL.**

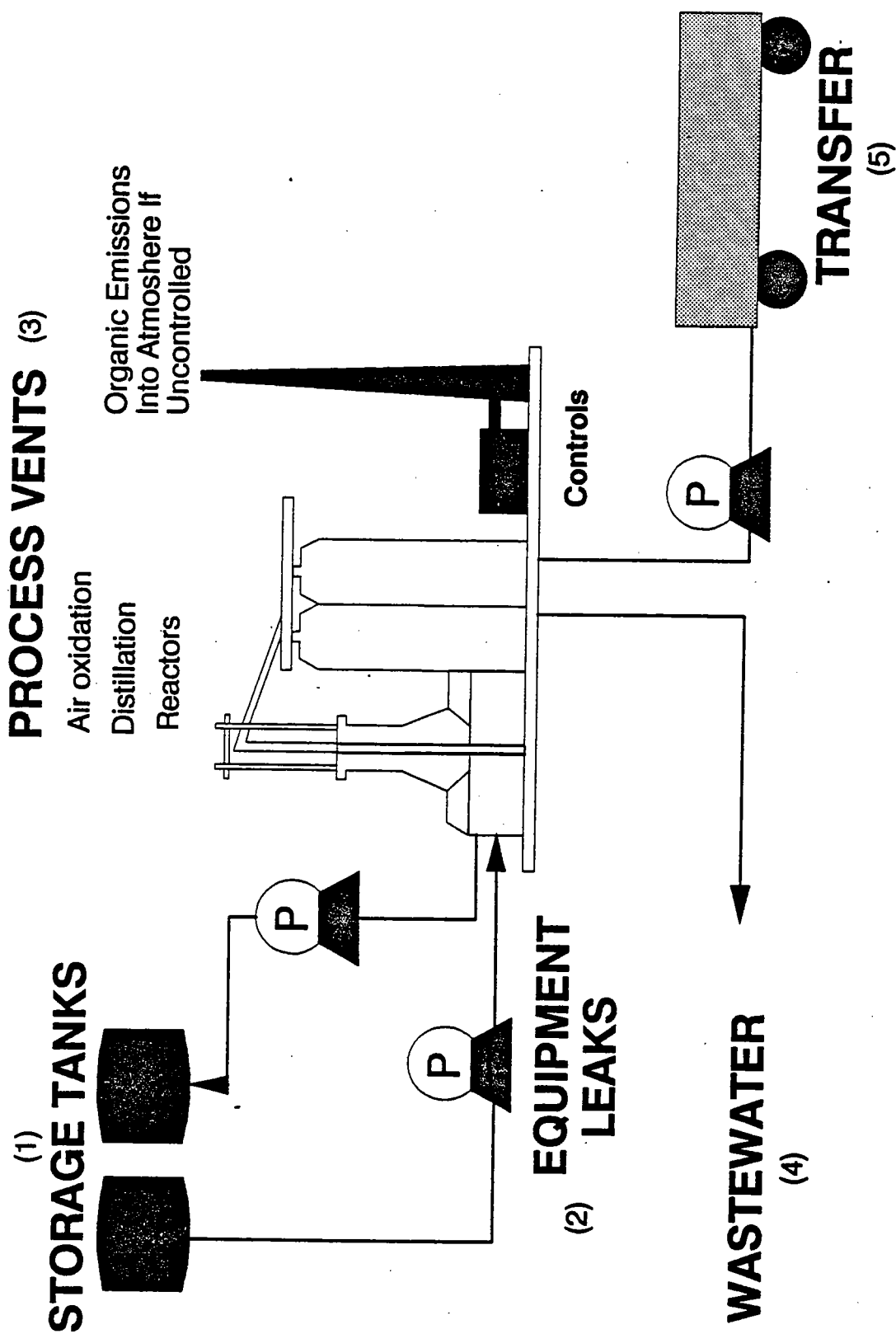
SCOPE OF HON (CONTINUED).

- **INCLUDES ABOUT 400 SUBCATEGORIES. TOTAL PRODUCTION CAPACITY FOR THESE CHEMICALS IS 70 MILLION METRIC TONS (Mg) PER YEAR.**
- **THE HON MAY AFFECT APPROXIMATELY 1,000 INDIVIDUAL PROCESS UNITS.**

HON EMISSION SOURCES

- **EQUIPMENT LEAKS**
- **PROCESS VENTS**
- **STORAGE VESSELS**
- **TRANSFER OPERATIONS**
- **WASTEWATER OPERATIONS**

WHAT ARE THE AFFECTED SOURCE TYPES?



DETERMINATION OF MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT)

- **INCLUDES SELECTION OF:**
 - (1) CONTROL TECHNIQUES INCLUDING
POLLUTION PREVENTION OPTIONS,
AND**
 - (2) APPLICABILITY CRITERIA TO
DETERMINE WHAT CLASSES,
TYPES, AND SIZES OF SOCMI
SOURCES ARE REQUIRED TO APPLY
CONTROL.**

DETERMINATION OF MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT) (CONTINUED)

- **CONTROL TECHNIQUES HAVE BEEN IDENTIFIED. THESE CONTROLS RESULT IN MAXIMUM EMISSION REDUCTION FOR EACH OF THE FIVE EMISSION SOURCE TYPES. THE SELECTION OF CONTROLS WAS BASED ON PAST AND CURRENT RULEMAKING EFFORTS.**
- **APPLICABILITY CRITERIA WILL BE THE FOCUS OF FUTURE REGULATORY OPTIONS DEVELOPMENT FOR THE HON.**

TABLE 1. CONTROL TECHNIQUES AND POLLUTION PREVENTION TECHNIQUES

SOURCE TYPES (CONTROL EFFICIENCY)	CONTROL TECHNIQUE	POLLUTION PREVENTION TECHNIQUES
EQUIPMENT LEAKS (85-88%)		LEAK DETECTION AND REPAIR, IMPROVED MAINTENANCE PRACTICE
PROCESS VENTS[*] (98%)	<ul style="list-style-type: none"> - FLARE - THERMAL INCINERATOR - THERMAL INCINERATOR PLUS SCRUBBER 	<ul style="list-style-type: none"> - INCREASED PRODUCT RECOVERY EFFICIENCY
STORAGE TANKS (~95%)		<ul style="list-style-type: none"> - INTERNAL FLOATING ROOF - CONDENSER

TABLE 1. CONTROL TECHNIQUES AND POLLUTION PREVENTION TECHNIQUES

SOURCE TYPES (CONTROL EFFICIENCY)	CONTROL TECHNIQUE	POLLUTION PREVENTION TECHNIQUES
TRANSFER OPERATIONS* (98%)	<ul style="list-style-type: none"> - FLARE - THERMAL INCINERATOR - THERMAL INCINERATOR PLUS SCRUBBER 	<ul style="list-style-type: none"> - PROCESS CHANGE (VAPOR BALANCING)
WASTEWATER (~95%)	STEAM STRIPPER	<ul style="list-style-type: none"> - PROCESS CHANGES TO REDUCE LOSSES - RECYCLING OF WASTES TO PROCESS

*EMISSIONS MAY ALSO BE VENTED TO EXISTING BOILERS OR PROCESS HEATERS AS AN ENERGY CONSERVATION MEASURE.

IMPACTS ANALYSIS

- **FOUR STEP APPROACH**
 - (1) **CHARACTERIZATION OF INDUSTRY
(E.G., PRODUCER IDENTIFICATION,
CAPACITY, PROCESS TYPE,
COMPLEXITY, GEOGRAPHIC LOCATION)**
 - (2) **DEVELOPMENT OF MODEL EMISSION
SOURCES UNIQUE TO EACH SOURCE
TYPE**
 - (3) **ASSIGNMENT OF MODELS TO EACH
PRODUCTION PROCESS**
 - (4) **ESTIMATION OF EMISSIONS,
EMISSIONS REDUCTIONS, AND
CONTROL COSTS**
- **CONSIDERS EXISTING CONTROL REQUIREMENTS**

ECONOMIC ANALYSIS

- **PURPOSES**

**(1) DETERMINE RESPONSE TO
REGULATIONS**

**(2) DETERMINE WHAT ADDITIONAL
ANALYSES ARE NEEDED**

ECONOMIC ANALYSIS (CONTINUED)

- **APPROACH FOR HON**
 - (1) CUMULATIVE COST**
 - (2) CHEMICAL COST INCREASES**
 - (3) SUBSET SELECTION FOR DETAILED ANALYSIS**
 - (4) MARKET ANALYSIS OF SUBSET**

REGULATORY OPTIONS DEVELOPMENT

- **REGULATORY OPTIONS WILL BE DEVELOPED FOR EACH OF THE FOUR EMISSION SOURCE TYPES (OPTIONS FOR EQUIPMENT LEAKS WILL NOT BE EVALUATED IN THE HON)**
- **ALL OPTIONS WILL BE AT LEAST AS STRINGENT AS THE MACT FLOORS**

REGULATORY OPTIONS DEVELOPMENT (CONTINUED)

- **REGULATORY OPTIONS WILL INCLUDE CONTROL LEVELS PREVIOUSLY PRESENTED (E.G., 95% HAP CONTROL BY CONDENSER FOR STORAGE) AND APPLICABILITY CRITERIA**
- **APPLICABILITY CRITERIA WILL INCLUDE MEASURABLE CHARACTERISTICS OF THE EMISSION SOURCE AND CHEMICAL PROPERTIES. SEE TABLE 2.**

TABLE 2. CANDIDATE APPLICABILITY CRITERIA

SOURCE TYPE	CANDIDATE APPLICABILITY CRITERIA
EQUIPMENT LEAKS	- HAP SERVICE (AT LEAST 5% BY WEIGHT)*
PROCESS VENTS	- FLOWRATE - HAP WEIGHT PERCENT - HEAT CONTENT
STORAGE	- TANK SIZE - VAPOR PRESSURE OF HAP

***HAS BEEN DETERMINED FROM REGULATORY
NEGOTIATION, WILL NOT BE ANALYZED FOR HON**

TABLE 2. (CONTINUED)

SOURCE TYPE	CANDIDATE APPLICABILITY CRITERIA
TRANSFER	- THROUGHPUT - VAPOR PRESSURE OF HAP
WASTEWATER	- FLOWRATE - VHAP CONCENTRATION

- **IMPACTS PRESENTED FOR REGULATORY OPTIONS**
 - **BASELINE EMISSIONS**
 - **MACT FLOOR**
 - **EMISSION REDUCTION (HAP AND VOC)**
 - **INCREMENTAL EMISSION REDUCTION**
 - **NUMBER AND PERCENT OF EMISSION SOURCES CONTROLLED**
 - **CONTROL COSTS (ANNUALIZED)**
 - **INCREMENTAL CONTROL COSTS**
 - **AVERAGE COST EFFECTIVENESS**
 - **INCREMENTAL COST EFFECTIVENESS**
 - **CHEMICAL COST INCREASES**

- **OTHER ENVIRONMENTAL AND ENERGY IMPACTS WILL ALSO BE ESTIMATED**
 - **ENERGY IMPACTS (BARRELS OF OIL EQUIVALENT)**
 - **WATER IMPACTS**
 - **SECONDARY AIR EMISSION IMPACTS**

INTERACTIONS WITH EXTERNAL GROUPS

**CMA
SOCMA
STAPPA/ALAPCO
NAM
NRDC**

HON PROJECT SCHEDULE

PROPOSAL	11/22/91
PROMULGATION	11/15/92



A Division of The Society of The Plastics Industry, Inc.

COMMENTS ON THE EPA HAZARDOUS ORGANIC NESHP (HON) PROJECT

The Vinyl Institute, a division of The Society of the Plastics Industry, Inc.^{1/} is pleased to provide these comments to the National Air Pollution Control Techniques Advisory Committee (NAPCTAC) on the U.S. Environmental Protection Agency's (EPA) project to regulate the Synthetic Organic Chemical Manufacturing Industry ("SOCMI") under the National Emission Standards for Hazardous Air Pollutants ("NESHP") for Hazardous Organics, otherwise known as the HON program.

Members of the Vinyl Institute represent the majority of domestic manufacturers of vinyl chloride, polyvinyl

^{1/} SPI is a 2,000 member not-for-profit trade organization representation all segments of the plastics industry in the United States. The Society's members include processors and manufacturers of plastics and plastic products, suppliers of raw material, processors and converters of plastic resins and manufacturers of accessory equipment for the plastic industry. Founded in 1937, SPI is the major national trade association of the plastics industry.

Members of the Vinyl Institute include the BF Goodrich Company, Borden Chemicals and Plastics Industries, CertainTeed Corporation, The Dow Chemical Company, Georgia Gulf Corporation, Occidental Chemical Corporation, PPG Industries, Inc., PW Resins, Shintech, Inc., and Vista Chemical. Members of the Vinyl Institute account for approximately 82% of the domestic production of vinyl chloride and 63% of the domestic production of polyvinyl chloride.

chloride, and ethylene dichloride. Because these substances are listed under newly amended section 112 of the Clean Air Act, and because many Vinyl Institute members fall within the SOCM I point source category, the developing HON regulations are of significant concern. EPA must carefully consider the interrelationship between specific standards for individual substances such as vinyl chloride and general standards such as those presented in the HON and equipment leaks proceedings.

A. REGULATORY CONTEXT

The Clean Air Act Amendments of 1990 direct EPA to establish source categories and subcategories for facilities emitting any of the listed hazardous air pollutants specified in Section 112(b). EPA must then promulgate regulations specifying maximum achievable control technology (MACT) for such categories and subcategories. The initial regulations will be subsequently followed by a residual risk analysis.

The current EPA proposal would establish broad MACT requirements for five emission sources -- process vents, wastewater treatment operations, storage tanks, transfer operations and equipment leaks. Equipment leaks are, however, addressed in a separate regulatory proceeding. EPA is to evaluate possible control technologies in light of specific source categories, emission levels, production rates or

capacities, chemical properties, or physical characteristics and based on its evaluation determine the appropriateness of mandating a particular control technology as MACT.

The list of hazardous air pollutants specified in Section 112(b) of the Clean Air Act includes chemicals for which EPA has already promulgated NESHAP regulations. For example, a NESHAP has been established for vinyl chloride which applies to vinyl chloride emissions from ethylene dichloride (EDC), vinyl chloride and polyvinyl chloride (PVC) manufacture. 40 C.F.R. § 61.60 (1989).

Vinyl chloride is one of only seven pollutants that were regulated under former Section 112 prior to the 1990 amendments. The rule was initially promulgated in 1976 and underwent extensive review leading to minor revisions in 1986. The rule was most recently amended in 1990. 41 Fed. Reg. 46561 (Oct. 21, 1976); 51 Fed. Reg. 34904 (Sept. 30, 1986); 55 Fed. Reg. 28346 (July 10, 1990). As part of the 1986 revisions, EPA reviewed available control technology. At that time, EPA concluded that there was no preferable process or control technology superior to that mandated by the standard. 50 Fed. Reg. 1182, 1183-1186 (Jan. 9, 1985).

The members of the Vinyl Institute are concerned about potential redundancy or conflict arising between a generally

applicable HON regulation and the existing vinyl chloride NESHAP. Concerns in this regard may be more clearly stated after reviewing the situation that might exist with regard to specific emission source types.

B. HON PROPOSAL AND THE VINYL CHLORIDE NESHAP

1. PROCESS VENTS

The control technology used as the basis for MACT determination for process vents would be a 98% control level achieved, for halogenated streams, by using a thermal incinerator plus acid gas scrubbing.^{2/}

In PVC plants, under the existing vinyl chloride standard, vinyl chloride emissions from resin driers are

^{2/} The overview of the EPA HON project is quite general. For example, in assessing emission reductions of 95% or 98%, we assume that the Agency is referring to a 98% reduction from uncontrolled emissions. We believe that a 95% or 98% reduction of existing emissions is clearly infeasible.

There are other characteristics of the EPA proposal that warrant clarification. For example, we assume, but it is not stated, that the percentage reduction figures address routine emissions. Episodal or emergency releases should not be part of this particular target figure, and EPA should state so explicitly. Similarly, some States will include fugitive emissions from piping and related equipment in a storage area as part of the storage equipment release figures. Under the EPA plan, such emissions are properly handled as equipment leaks, not as storage tank emissions. This should also be made explicit.

controlled by stripping vinyl chloride from the PVC resin before drying. This provision was incorporated into the existing vinyl chloride NESHAP due to (1) the technical and economic infeasibility of controlling vinyl chloride emissions from the large-air volume, high-moisture, low vinyl chloride-containing drier exhaust stream and (2) the emissions of other pollutants associated with combustion.^{3/} Since the vinyl chloride NESHAP was first promulgated 17 years ago, the PVC industry's utilized and perfected resin stripping technology. This has resulted in reduction of vinyl chloride emissions far below the levels contemplated when the original rule was developed.

A similar situation exists with PVC reactor opening emissions. The existing vinyl chloride emissions limit was based on the use of a reactor steam sweep and/or clean reactor technology. These technologies reduce the potential for vinyl chloride emissions before opening the reactor to the atmosphere. 40 C.F.R. § 61.64(a). This technology has advanced over the years to the point where actual emissions today are significantly less than those contemplated by the original NESHAP regulations.

^{3/} For example, increased NO_x, CO, CO₂ levels and energy consumption requirements associated with additional incineration.

PVC plants utilize combustion technology and/or absorber/stripper technology to control all in-process vents to the 10 parts per million (ppm) level specified in the existing vinyl chloride NESHAP. 40 C.F.R. § 61.64(b). The HON currently being considered by EPA could be interpreted to prohibit the use of absorber/stripper technology. This would result in unproductive expenditures for the PVC industry because vinyl chloride emissions are very effectively controlled through the use of an absorber/stripper technology. In addition, use of absorber/stripper technology results in the recovery and reuse of vinyl chloride and does not produce combustion related emissions.

Resin stripping and reactor steam sweeping might be characterized as a process modification rather than end-of-the-stack or end-of-the-pipe control. As such, it is consistent with EPA's new focus on process modification in lieu of end-of-the-stack controls. Further, EPA should, whenever possible, promulgate standards that require certain emission reduction performance rather than specifying the use of particular control technologies. Thus, in-process controls, such as slurry stripping and reactor purging, should be considered MACT, instead of requiring add-on incineration or similar control devices.

2. WASTEWATER TREATMENT OPERATIONS

The vinyl chloride NESHAP currently requires that inprocess wastewater be stripped to 10 ppm or less for vinyl chloride. 40 C.F.R. § 61.65(b)(9). This is comparable to the benzene wastewater NESHAP in which the HON is based on wastewater treatment. Therefore, the existing vinyl chloride standard meets control technology candidates that EPA has identified as a basis for establishing MACT criteria.

3. STORAGE

The EPA proposal would require approximately 95% pollutant control, with the exact level of control depending on individual chemical properties. The vinyl chloride industry exceeds the 95% control criteria, since vinyl chloride is stored in unvented pressurized tanks. Indeed, except for emergency relief discharges, the vinyl chloride standard states that "there is to be no discharge to the atmosphere from any relief valve on any equipment in vinyl chloride service." 40 C.F.R. § 61.65(a); see also § 61.65(b)(5) (similar limitation on manual venting).^{4/}

^{4/} "In vinyl chloride service" means that a piece of equipment either contains or contacts a liquid that is at least 10 percent vinyl chloride by weight or a gas that is at least 10 percent by volume vinyl chloride" 40 C.F.R. § 61.61(1).

4. TRANSFER OPERATIONS

Under the EPA proposal, the Agency envisions a 90% reduction in hazardous air pollutant emissions resulting from transfer operations following the same guidelines that would apply to process vents. The current vinyl chloride standard already addresses this situation. 40 C.F.R. § 61.65(b)(1). Emissions from any loading or unloading lines in vinyl chloride service are to be minimized by purging the lines and venting any removed vinyl chloride through a control system whose exhaust gas does not exceed 10 ppm vinyl chloride.

5. EQUIPMENT LEAKS

Equipment leaks would be addressed by EPA through the Regulatory Negotiation process. In any event, we note that equipment leaks (fugitive emissions) are addressed extensively under the vinyl chloride NESHAP. 40 C.F.R. § 61.65(b). We certainly understand the Agency's desire to apply the equipment leak provisions developed in the Regulatory Negotiation process to facilities not covered by the vinyl chloride NESHAP. Under this strategy, however, either the vinyl chloride NESHAP or the Regulatory Negotiation provisions could apply, not both. The overlap or redundancy created by applying both sets of requirements would be unnecessary, confusing and counterproductive.

C. COORDINATING GENERIC AND SPECIFIC STANDARDS

The Vinyl Institute requests that EPA carefully consider the requirements of the existing vinyl chloride NESHAP and the technologies currently employed and developed by the vinyl industry in evaluating appropriate MACT control. EPA should allow equivalent control technologies to avoid redundancy and duplicity of generic MACT requirements with existing vinyl chloride NESHAP requirement.

MACT is defined under Section 112(d)(3) for existing standards as controls equivalent to the average of those presently employed at the most tightly controlled existing facilities.^{5/} Under this approach, the average emission

5/ MACT is broadly defined in Section 112(d)(3) as follows:

The maximum degree of reduction in emissions that is deemed achievable for new sources in a category or subcategory shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Administrator. Emission standards promulgated under this subsection for existing sources in a category or subcategory may be less stringent than standards for new sources in the same category or subcategory but shall not be less stringent, and may be more stringent than --

(A) the average emission limitation achieved by the best performing 12 percent of the existing sources (for which the Administrator has emissions information), excluding those sources that have, within 18 months before the emission standard is proposed or within 30 months before such standard is promulgated, whichever is later, first achieved a level of emission rate

limitation of the best 12% of existing sources or the best performing 5 sources, depending on industry size, will indicate that the vinyl chloride NESHAP-mandated technology is MACT. For example, the vinyl industry is not aware of any plans that control downstream emissions from resin other than through stripping before the drier.

Part of EPA's policy in implementing the Clean Air Act Amendments of 1990 is referred to as E³. By this, the Agency means that it will achieve and maintain a healthy environment while supporting strong and sustainable economic growth and sound energy policy.^{6/} The use of process modifications to achieve emission reductions, instead of end of the stack incineration, is consistent with EPA's energy conservation and "cleanest, technologically feasible manner" policy.^{7/}

5/ (...continued)

or emission reduction which complies, or would comply if the source is not subject to such standard, with the lowest achievable emission rate (as defined by section 171) applicable to the source category and prevailing at the time, in the category or subcategory for categories and subcategories with 30 or more sources, or

(B) the average emission limitation achieved by the best performing 5 sources (for which the Administrator has or could reasonably obtain emissions information) in the category or subcategories with fewer than 30 sources.

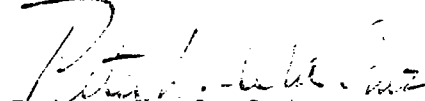
6/ See EPA Office of Air and Radiation, Implementation Strategy for the Clean Air Act Amendments of 1990, at 7 and Figure 1 (Jan. 15, 1991).

7/ Id. at 7.

Moreover, the policy explicitly encourages market-based principles and other innovative approaches, such as "performance-based standards."^{8/}

The Vinyl Institute endorses this approach. The existing process and emission performance standards contained in the current vinyl chloride NESHAP standard are consistent with this policy. The Vinyl Institute would be happy to provide additional detail to the Committee or EPA.

Respectfully submitted,



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January 30, 1991

^{8/} Id. at 7.

STATEMENT OF
W. C. HOLBROOK
ON BEHALF OF
THE CHEMICAL MANUFACTURERS ASSOCIATION
BEFORE THE
NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE
ON THE
HAZARDOUS ORGANIC
NATIONAL EMISSION STANDARDS
FOR HAZARDOUS AIR POLLUTANTS

JANUARY 30, 1991

CHEMICAL MANUFACTURERS ASSOCIATION
TESTIMONY BEFORE THE NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE ON
EPA'S PROJECT TO DEVELOP NATIONAL EMISSION STANDARDS
FOR HAZARDOUS AIR POLLUTANTS (NESHAP)
FOR HAZARDOUS ORGANICS

My name is W.C. Holbrook. I am Director of Environmental Affairs for the Chemical Group of BF Goodrich. I am speaking to you today on behalf of the Chemical Manufacturers Association (CMA) where I serve as a member of the Air Toxics Work Group. CMA is a nonprofit trade association whose member companies represent over 90 percent of the production capacity of basic industrial chemicals in the United States. We are pleased to have this opportunity to present our views to the National Air Pollution Control Techniques Advisory Committee.

CMA played an active role in shaping the new Section 112 provisions in the Clean Air Act Amendments of 1990 as they relate to development of Maximum Achievable Control Technology (MACT) standards. CMA was a strong supporter of the MACT concept and believes it represents an effective way of achieving significant reductions in emissions of hazardous air pollutants.

CMA further supports the efforts at EPA to set MACT standards for sources of hazardous air pollutants in the chemical manufacturing industry through a hazardous organic NESHAP, otherwise known as the "HON." We believe such an approach is a practical way of regulating a significant number of sources of hazardous air pollutants within the time frames specified in the Clean Air Act Amendments. However, CMA has several suggestions for strengthening EPA's approach for setting MACT standards under the HON project which we would like to summarize today. Our suggestions fall into the following general areas:

- 1) EPA plans to apply the HON to almost 400 different chemical manufacturing processes. EPA must be careful to take into account unique differences among these processes when developing standards.
- 2) EPA has identified possible control technology approaches for MACT based on recent rulemakings for the Synthetic Organic Chemical Manufacturing Industry (SOCMI). CMA encourages EPA to retain features in these recent regulations that provide flexibility to facilities to use different types of control technologies to comply with the regulations. Furthermore, CMA encourages EPA to develop a straightforward process for demonstrating equivalent approaches that may be developed in the future.

- 3) EPA has indicated that the MACT decision process involves selecting both a control technology and applicability criteria. CMA concurs that selection of appropriate applicability criteria is an essential step toward sound, workable regulations. Once again, CMA encourages EPA to use the applicability framework already developed as part of recent rulemakings for chemical industry sources as a starting point for identifying appropriate applicability criteria for the MACT standards.
- 4) Sources of benzene and vinyl chloride are already regulated under existing NESHAP regulations. EPA should guard against unnecessary duplication and confusion when setting MACT standards for these previously regulated sources. CMA urges EPA to consider sources that are subject to existing NESHAP requirements to be in compliance with MACT to avoid costly new requirements with no environmental benefit.

The rest of my oral comments will elaborate on these points.

As part of the HON project, EPA is developing regulations that will cover five emissions source types found in chemical manufacturing facilities. These are: process vents, wastewater treatment operations, storage, transfer operations, and equipment leaks. CMA supports EPA's plans to issue standards for all of these sources within a process unit concurrently. This will enable facilities to know the full range of MACT controls that will be required within a particular process unit to reduce hazardous organic air pollutants. This in turn will allow facilities to implement controls in the most efficient way possible. Although CMA supports EPA's approach for issuing standards for all five source types concurrently for a particular process unit, CMA has commented earlier in this meeting that it recommends that EPA phase in regulations by applying them to different categories of process units over time.

Accounting for Differences Between Processes Covered by the HON

Under the HON, EPA plans to regulate emissions of hazardous organics from an estimated 388 different types of chemical manufacturing processes. CMA is concerned that a single regulation may not adequately take into account unique differences represented among the 388 different processes. The obvious solution to this dilemma would be for EPA to evaluate and set MACT standards for each process separately. However, CMA understands that such an approach may be impractical given limitations in Agency resources and the stringent schedules prescribed by the Clean Air Act Amendments. Nonetheless, CMA believes that it is important that the HON attempt to identify and address unique differences between processes. For example, as EPA already recognizes, different control technologies are indicated for process vent streams containing halogenated compounds versus non-halogenated compounds. Other process specific characteristics such as temperature, pressure, and concentration of hazardous pollutants may also indicate the need for different control requirements. CMA is currently evaluating differences in processes to assist EPA in

identifying the need for separate control requirements. We will share the results of our efforts with EPA as soon as they are available.

Equipment Leaks

CMA was a key participant in the recently concluded negotiations to develop MACT standards for equipment leaks. CMA supports the equipment leaks regulation as drafted by the Negotiating Committee. Therefore, the remainder of our comments today are limited to EPA's approach for regulating the remaining four source types.

Process Vents

CMA urges EPA to consider incorporation of flexibility in the MACT standard, both from control technology and control efficiency points of view. The recently promulgated New Source Performance Standards for SOCM Distillation and Air Oxidation processes provided flexibility to comply using a variety of combustion and recovery techniques. CMA believes that such flexibility is a critical element in MACT standards, especially as they apply to existing sources where a wide variety of effective control technologies are already in place. Failure of the MACT standards to allow for use of different types of control technologies would in some cases require facilities to replace existing control equipment with new equipment at significant cost and no resulting environmental benefit. Therefore, CMA encourages EPA to retain in the MACT standards for process vents the features in these recent rulemakings that provide for use of different types of control technologies.

In addition, the MACT standards should provide opportunity and incentive for facilities to apply new, innovative control technologies. This can be accomplished by providing flexibility within the standards themselves and by establishing a straightforward process for facilities to demonstrate that new approaches developed in the future are equivalent to the standards.

In selecting MACT for process vents, the control device efficiency should not be the sole criteria. As directed by Congress in Section 112(d)(2) of the Clean Air Act Amendments, EPA should consider other factors such as overall environmental impact, recovery and recycle, and multi-media impact. For example, catalytic incinerators operate at a lower temperature than thermal incinerators, therefore they generate less NOx emissions. NOx emissions are a contributor to ozone formation. EPA should weigh the advantages of significantly lower NOx emissions against slightly lower emissions of hazardous organic emissions when identifying control technology candidates for MACT.

Similarly, if a stream can be recycled to the process, by recovery techniques such as adsorption, absorption or condensation, then such practices should have preference over disposal techniques such as incineration - even if the control efficiency falls somewhat short of that achieved by incineration.

Likewise, if a process can be so modified that the formation of a pollutant is prevented, instead of destroying or capturing the formed pollutant, then the prevention should be favored over control. Prevention of formation of an air pollutant avoids the problem associated with the disposal of wastewater and/or solid waste generated in controlling that air pollutant.

The second critical element of the MACT standard setting process for process vents is the development of applicability criteria. EPA incorporated such criteria in its recently promulgated NSPS for SOCM Distillation and Air Oxidation operations. Specifically, the concept of Total Resource Effectiveness in these regulations is an effective means of accounting for the characteristics of a vent stream in determining whether additional controls are required. CMA urges EPA to retain these concepts when developing the applicability criteria for the MACT standards for process vents.

CMA has one final point related to process vents. It is not clear if the percent control efficiency is to be measured on the basis of all hazardous air pollutants combined or each specific pollutant. CMA believes that the control efficiency basis should be all hazardous air pollutants combined for several reasons. First, the Clean Air Act Amendments of 1990 require EPA to develop MACT standards for categories of major sources not for specific pollutants. Second, it may be difficult to achieve a single percent control efficiency for each individual pollutant, especially those with low inlet concentrations, due to variability in chemical and physical properties.

Wastewater Treatment

In selecting MACT standards for wastewater treatment units, CMA believes that it is important that the EPA utilize a database which represents wastewater treatment practices and emission potential for the variety of chemical manufacturing processes that are expected to be covered. EPA has not had occasion to develop such a data base for wastewater treatment unit operations as they have for other chemical manufacturing industry sources such as process vents, equipment leaks, and storage tanks which have been previously regulated under New Source Performance Standards. A representative data base is essential if EPA is to properly account for unique differences between different chemical manufacturing processes when developing MACT standards for wastewater treatment.

As with process vents, the control strategy for wastewater treatment sources should be flexible to take into account the wide range of wastewater treatment plant designs. For example, while steam stripping is one technique for reducing emissions from wastewater treatment systems, the standards should allow other methods that achieve the same reductions.

The applicability criteria for the MACT standards for wastewater treatment are particularly critical. Process conditions, such as flow rate, temperature, and concentration of wastewater constituents should be included as applicability criteria. In addition, the standards should take into account the volatility of hazardous air pollutants in wastewater streams. One method for accounting for volatility would be to establish minimum concentration levels requiring control as a function of volatility, i.e., vapor pressure and vapor liquid equilibrium behavior such as Henry's Law constant. Under this approach, streams containing pollutants with high volatility would require controls at lower concentrations than would streams containing pollutants with low volatility.

CMA offers one final point relating to the applicability criteria for wastewater treatment standards. The test method that EPA provides for determining concentration of wastewater components will have a significant impact on applicability determinations. CMA has previously provided comments on EPA's proposed Reference Test Method 25D which is expected to be applied to wastewater stream measurements. CMA would like to continue to work with EPA as it completes development of this test method.

Storage

As in the case of process vents, CMA recommends that the MACT standard for storage tanks provide for flexibility in control technologies that achieve the same level of control. In addition, the applicability criteria should be similar in concept to that provided in the NSPS for Volatile Organic Liquid Storage. Specifically, the need for controls should depend both upon the size of the tank and the volatility of the hazardous pollutants being stored.

Transfer Operations

Control technology flexibility is equally important for the MACT standards for transfer operations as for process vents and storage tanks. In addition, CMA suggests that the applicability criteria for transfer operations take into account the volatility of the hazardous pollutant being transferred in addition to those criteria already incorporated into the recently promulgated NESHAAP for Benzene Transfer Operations.

Sources Covered Under Existing NESHAP Regulations

CMA member companies currently subject to NESHAP regulations for benzene and vinyl chloride are concerned about the duplicative potential of MACT regulations. In establishing the HON regulations, EPA should assure that confusion and duplication does not occur. For example, EPA should consider sources that are subject to existing NESHAP requirements for benzene or vinyl chloride that have controls that are at least as stringent as MACT requirements to be in conformance with MACT. Furthermore, EPA should avoid imposing duplicative monitoring and recordkeeping requirements on sources subject to benzene and vinyl chloride NESHAP requirements where such requirements provide no environmental benefit. In the event that EPA chooses to apply MACT to sources already covered by existing NESHAPs, CMA believes that EPA should repeal the existing NESHAP regulations.

CMA looks forward to working with EPA as they continue development of the HON regulations.

This concludes my remarks. I'll be happy to answer any questions.

DISCUSSION

Committee member Ralph Hise (Advanced Technologies Management) commented that EPA should coordinate HAP and NO_x standards, as decreased HAP emissions may lead to increased NO_x emissions. Jim Weigold (EPA) concurred that such coordination was important.

Committee member John Pinkerton (NCASI) asked CMA to elaborate on wastewater treatment, inquiring whether volatility should be a criteria. Mr. Holbrook replied that the volatile HAPs result in greater emissions than non-volatile HAPs. Existing benzene and vinyl chloride regulations should also be considered. Concentration levels are also important criteria; CMA recommends concentration cutoffs of at least 10 ppm. Mr. Pinkerton also asked whether the proposed Reference Test Method 25D considered differences in volatility. Penny Lassiter, EPA, replied that parameters were set to effect removal of the volatile materials. Mr. Pinkerton then commented that VOC activity in biological systems should be explored, as wastewater treatment regulations could result in dispersement of VOCs into biological wastewater treatment systems. Mr. Pinkerton added that the CHEMDAT.7 model may be an answer. Mr. Holbrook replied that CMA is exploring these issues under SARA 313 emission reporting. He also added that enclosing wastewater treatment systems and ducting to control devices may be more cost effective than other methods.

Vivian McIntire asked whether there was a difference between reactants and raw materials on the CMA list of organic HAPs. Ms. McIntire also asked whether solvents were regulated. Mr. Rosensteel replied that solvents were not regulated. Mr. Holbrook requested clarification from EPA regarding whether there is any difference between reactants and raw materials. Mr. Rosensteel replied that use of a HAP is covered only if it is used to produce a SOCM chemical, but not if it is used to produce a non-SOCMI chemical. One exception to this is that the equipment leaks negotiated regulation does cover seven specific non-SOCMI processes.

XI. Asbestos NESHAP Comprehensive Revision

Status Report To The NAPCTAC

EPA PRESENTATION

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SLIDE 1

This is a status briefing of the asbestos NESHAP revision project which is being conducted under the Clean Air Act Amendments of 1990.

SLIDE 2

I will first present some background information which is important to understand the history of asbestos regulations under the Clean Air Act and to help establish the baseline for comparison of the impacts of the revisions that are being considered. I will also present the purpose of the revisions and will discuss each of the revisions under consideration and their associated options. I will then discuss the preliminary impacts and the schedule for the project.

NAPCTAC STATUS BRIEFING

ASBESTOS NESHAP REVISIONS

JANUARY 30, 1991

CONTENTS OF BRIEFING

- **BACKGROUND**
- **PURPOSE OF REVISIONS**
- **REVISIONS UNDER CONSIDERATION**
- **PRELIMINARY IMPACTS**
- **SCHEDULE**

SLIDE 3

Asbestos was listed as a hazardous air pollutant in 1971. The first asbestos NESHAP regulations were proposed in 1971 and promulgated as a final rule in 1973. Major revisions to these regulations were made in 1975 and 1978.

In 1977, EPA lost a court case decision regarding the use of work practice standards rather than emission standards. This court case cast doubt on the enforceability of parts of the demolition and renovation regulation. Also in 1977, the CAA was amended to allow NESHAP work practice standards.

The asbestos NESHAP was repropoed in 1983 and repromulgated in 1984 to clear up any questions regarding the enforceability of the asbestos regulations.

On November 20, 1990 the asbestos NESHAP regulations were revised to clarify wording, to codify enforcement determinations and to implement recordkeeping and reporting requirements to help improve the enforceability of the regulations. There were no changes to the stringency of the regulations.

BACKGROUND (REGULATORY HISTORY)

- **1971 - ASBESTOS LISTED**
- **1971 - FIRST ASBESTOS NESHAP PROPOSED**
- **1973 - FIRST ASBESTOS NESHAP PROMULGATED**
- **1975 AND 1978 - ASBESTOS NESHAP REVISED**
- **1977 - COURT CASE DECISION REGARDING NESHAP WORK PRACTICE STANDARDS**
- **1977 - CAA AMENDED TO ALLOW NESHAP WORK PRACTICE STANDARDS**
- **1984 - ASBESTOS NESHAP REPROMULGATED**
- **1990 - ASBESTOS NESHAP REVISED**

SLIDE 4.

I will now summarize the major requirements of the current asbestos NESHAP regulations. This discussion is important to understand the revisions that are being considered in this project and which will be discussed later during the presentation.

For asbestos milling, manufacturing, and fabricating sources the asbestos NESHAP requires that asbestos emissions to the outside air be controlled using control devices that meet certain equipment specifications or optionally meet a no visible emission standard. (Please note that the no visible emission standard also applies as an option to several other parts of the asbestos NESHAP regulation.) The regulations also require that asbestos waste be collected and disposed of by using specified work practices or meet a no visible emission standard. The waste generator is also required to initiate a waste shipment record and assure that the waste shipment record arrives at the waste disposal site in conjunction with the asbestos waste.

The demolition and renovations of buildings regulation do not apply to single family homes or to four or fewer unit apartment buildings. In addition, there is a quantity cutoff of 160 square feet of surface asbestos material, 260 linear feet on pipes and ducts or a volume of 1 cubic meter of asbestos-

BACKGROUND (CURRENT NESHAP REQUIREMENTS)

- **MILLING, MANUFACTURING, AND FABRICATING**
 - **CONTROL ASBESTOS EMISSIONS**
 - * **EQUIPMENT SPECIFICATIONS OR NO VISIBLE EMISSIONS**
 - **COLLECT AND DISPOSE OF WASTE**
 - * **WORK PRACTICES OR NO VISIBLE EMISSIONS**
 - * **WASTE SHIPMENT RECORD**
- **DEMOLITION AND RENOVATION**
 - **NOTIFICATION**
 - **WET REMOVAL**
 - * **WORK PRACTICES**
 - **COLLECT AND DISPOSE OF WASTE**
 - * **WORK PRACTICES OR NO VISIBLE EMISSIONS**
 - * **WASTE SHIPMENT RECORD**

containing material. The regulations apply to friable asbestos-containing material or nonfriable asbestos-containing material that is or could be damaged. A distinction is made between categories of nonfriable materials. The regulation has inspection and notification requirements and requires adequate wetting and removal of regulated asbestos materials. The waste must be collected and disposed of using specified work practices or optionally meet a no visible emission standard. A waste shipment record is also required.

SLIDE 4A

The asbestos NESHAP regulations apply to active waste disposal sites. The regulation requires daily coverage with 6 inches of cover or optionally meet a no visible emission standard. The waste disposal site operator is required to keep records on the location and quantity of where asbestos was deposited and to attach such information to the deed when the site becomes inactive. The waste disposal site operator is also required to keep waste shipment records for a period of 2 years.

Inactive sites that were operated by milling, manufacturing, or fabricating sources covered by the asbestos NESHAP regulation require 24 inches of cover or optionally meet a no visible emission standard. In addition, there is a requirement that quantity and location information be attached to the property deed.

BACKGROUND (CURRENT NESHAP REQUIREMENTS) (CONTINUED)

- **WASTE DISPOSAL SITE**

- **ACTIVE SITES**

- * **COVER DAILY WITH 6 INCHES OF COVER OR NO VISIBLE EMISSIONS**
 - * **KEEP RECORDS ON LOCATION AND QUANTITY OF ASBESTOS WASTE**
 - * **WASTE SHIPMENT RECORD**

- **INACTIVE SITES (OPERATED BY AFFECTED FACILITIES)**

- * **COVER WITH 24 INCHES OF COVER OR NO VISIBLE EMISSIONS**
 - * **ATTACH QUANTITY AND LOCATION INFORMATION TO PROPERTY DEED**

- **INSULATION, SPRAYING AND ROADWAYS**

- **PROHIBIT USE OF PIPE INSULATION CONTAINING MORE THAN 1% COMMERCIAL ASBESTOS**
 - **PROHIBIT SPRAYING OF MATERIALS CONTAINING MORE THAN 1% ASBESTOS, EXCEPT FOR EQUIPMENT AND MACHINERY**
 - **PROHIBIT USE OF ASBESTOS WASTE ON ROADWAYS**

The asbestos regulation prohibits: (1) the use of pipe insulation containing more than 1% commercial asbestos, (2) the spraying of materials containing more than 1% asbestos, except for equipment and machinery, and (3) prohibits the use of asbestos waste on roadways.

SLIDE 5

In addition to the asbestos NESHAP regulations there are other regulations which regulate asbestos and are important in determining the regulatory baseline for the revisions that are being considered in this project.

The Environmental Protection Agency has two other environmental regulations beside the asbestos NESHAP that control asbestos. Both of these regulations were developed under the Toxic Substance Control Act. The Asbestos Hazard Emergency Response Act (AHERA) applies only to schools and has some requirements which are more stringent than the asbestos NESHAP. The asbestos ban and phase out rule requires a staged ban of approximately 94% of the asbestos used in the US. The last phase of the ban will take effect in 1996.

The Occupational Safety and Health Administration (OSHA) have regulations to protect workers which in some cases may also reduce emission to the outside air. The OSHA regulations have worker exposure limits that must be adhered to and also requires

BACKGROUND (OTHER ASBESTOS REGULATIONS)

- **EPA**
 - **AHERA**
 - **BAN AND PHASEDOWN**
- **OSHA**
 - **PERMISSIBLE EXPOSURE LIMIT**
 - **WORK PRACTICES**
- **DOT**
- **STATE REGULATIONS**

work practices in some cases. The OSHA regulations are currently being revised. The Department of Transportation have regulations which require that asbestos waste be packaged in a certain manner when shipped and also require that shipping papers be sent along with the waste. Many States have regulations which regulate emissions of asbestos. Most State regulations are more stringent than the NESHAP regulations in at least some respect. For example, most states have renovation regulations that are more stringent than the NESHAP requirements.

SLIDE 6

I will only discuss the 1990 CAA requirements that specifically pertain to asbestos. The Clean Air Act and its provisions under the 1990 amendments were discussed in detail yesterday. The emissions from sources of asbestos emissions are less than 10 tons per year, therefore, asbestos sources are classified as area sources. This designation may change depending on whether a lesser quantity cutoff is established for asbestos. In the case of area sources either MACT or GACT may be used to establish standards.

SLIDE 7

The reasons for considering asbestos revisions at this time is that asbestos is a listed toxic pollutant in the 1990 CAA and is a known human carcinogen. Other regulations that regulate

BACKGROUND

(CLEAN AIR ACT AMENDMENTS OF 1990)

- **ASBESTOS EMISSIONS; MAINLY AREA SOURCES**
- **MAY CHANGE DEPENDING ON WHETHER A LESSER QUANTITY CUTOFF IS ESTABLISHED FOR ASBESTOS**
- **FOR AREA SOURCES, EITHER MACT OR GACT MAY BE USED**

PURPOSE OF ASBESTOS REVISIONS

- **ASBESTOS IS LISTED AS AN AIR TOXIC POLLUTANT IN THE 1990 CAA**
- **ASBESTOS IS A KNOWN HUMAN CARCINOGEN**
- **OTHER REGULATIONS HAVE MORE STRINGENT REQUIREMENTS COMPARED TO THE ASBESTOS NESHAP, IN SOME CASES**
- **NEED FOR ASSESSMENT TO DETERMINE MACT OR GACT**

asbestos for different reasons than the asbestos NESHAP have more stringent requirements and therefore, there is a need for an assessment to determine MACT or GACT for various revisions to the asbestos NESHAP.

SLIDE 8

The revisions under consideration for the milling, manufacturing, and fabrication portions of the regulation are:

- (1) the application of high efficiency particulate air (HEPA) filters after currently required control devices, (2) requiring equipment specifications and a no visible emission standard, and
- (3) shutdown of malfunctioning control devices.

SLIDE 9

The revisions that are being considered for the demolition and renovations portion of the regulations include:

- (1) Maintenance of asbestos on facility components by requiring inspection and repair of damaged asbestos material, (2) reducing the quantity cutoff for application of the NESHAP work practices, (3) requiring the use of negative pressure and HEPA filter enclosure systems for renovations and/or demolitions.

SLIDE 10

Other revisions under consideration for demolition and renovations include: (1) requiring a protocol for bulk sample

REVISIONS UNDER CONSIDERATION (MILLING, MANUFACTURING, AND FABRICATION)

- **HIGH EFFICIENCY PARTICULATE AIR (HEPA) FILTERS AFTER CURRENTLY REQUIRED CONTROL DEVICES**
 - **HEPA FILTERS ON ALL GAS EXHAUST STREAMS**
 - **OPACITY MONITORING ON EXISTING CONTROL DEVICES AND HEPA FILTERS ON NEW OR MODIFIED CONTROL DEVICES**
- **NO VE AND EQUIPMENT SPECIFICATIONS**
- **SHUTDOWN MALFUNCTIONING CONTROL DEVICES**

REVISIONS UNDER CONSIDERATION (DEMOLITION AND RENOVATION)

- **MAINTENANCE OF ASBESTOS ON FACILITY COMPONENTS**
 - **REQUIRE INSPECTION AND REPAIR OF DAMAGED ASBESTOS MATERIAL**
- **REDUCE QUANTITY CUTOFF**
 - **DELETE QUANTITY CUTOFF**
 - **REDUCE QUANTITY CUTOFF**
- **NEGATIVE PRESSURE/HEPA FILTER**
 - **REQUIRE FOR INSIDE RENOVATION OF OCCUPIED BUILDINGS**
 - **REQUIRE FOR ALL DEMOLITIONS AND RENOVATIONS**

**REVISIONS UNDER CONSIDERATION
(DEMOLITION AND RENOVATION)
(CONTINUED)**

- **PROTOCOL FOR BULK SAMPLE COLLECTION**
- **WETTING AGENTS**
- **PROCEDURES FOR NONFRIABLE MATERIALS**
- **CONTROLS DURING WASTE HANDLING**
 - **REQUIRE WORK PRACTICES, ELIMINATE NO VE AS A COMPLIANCE OPTION**
 - **REQUIRE BOTH WORK PRACTICES AND NO VE**
- **ADEQUACY OF REMOVAL (CLEANLINESS STANDARD)**
 - **REQUIRE POST ABATEMENT DOUBLE CLEANING AND VISUAL INSPECTION**
 - **REQUIRE POST ABATEMENT DOUBLE CLEANING, VISUAL INSPECTION, AND CLEARANCE MONITORING**

collection, (2) requiring the use of wetting agents rather than just water for wetting materials prior to removal, (3) covering all friable and nonfriable ACM under the NESHAP, (4) requiring work practices or work practices and no visible emissions during waste handling, and (5) requiring a cleanliness standard which would require double cleaning, visual inspection and/or clearance monitoring.

SLIDE 11

Other revisions under consideration for demolition or renovation are: (1) procedures for handling and disposal of bulk waste, (2) procedures to identify nonnotifiers, (3) requiring viewing ports in enclosures, (4) controlling runoff from wetting and showers, (5) controlling the storage of waste at demolition or renovation sites and (6) requiring training and certification for various groups who work in the asbestos industry. The training and certification revision will probably be dropped from this project since a recent amendment to the Toxic Substances Control Act requires that EPA establish training and certification requirements for various occupations related to the removal of asbestos from public and commercial buildings.

SLIDE 12

Revisions that are being considered for active waste disposal sites are: (1) requiring an intermediate thickness of

**REVISIONS UNDER CONSIDERATION
(DEMOLITION AND RENOVATION)
(CONTINUED)**

- **HANDLING AND DISPOSAL OF BULK WASTE**
- **IDENTIFY NONNOTIFIERS**
 - **NOTIFY DEMOLITION PERMIT APPLICANTS OF ASBESTOS NESHAP REQUIREMENTS**
 - **NOTIFY RENOVATION PERMIT APPLICANTS OF ASBESTOS NESHAP REQUIREMENTS**
 - **COLLECT INFORMATION ON CONSTRUCTION PERMIT**
- **VIEWING PORTS IN ENCLOSURES**
- **CONTROL RUNOFF FROM WETTING AND SHOWERS**
- **WASTE STORAGE**
- **TRAINING AND CERTIFICATION**

REVISIONS UNDER CONSIDERATION (WASTE DISPOSAL)

- **INTERMEDIATE THICKNESS OF COVER**
 - **12 INCHES INTERMEDIATE COVER**
 - **18 INCHES INTERMEDIATE COVER**
- **FINAL THICKNESS OF COVER**
 - **REQUIRE 36 INCHES FOR ALL INACTIVE SITES**
 - **REQUIRE AT LEAST 12 INCHES MORE THAN DEPTH OF FROST PENETRATION, AND A MINIMUM OF 24 INCHES COVER**

cover of either 12 inches or 18 inches, and (2) for inactive sites, requiring a final thickness of cover of 36 inches for all inactive disposal sites or requiring a variable thickness of cover of at least 12 inches more than the frost penetration, and a minimum of 24 inches of cover.

SIDE 13

Other revisions that are being considered for waste disposal are: (1) requiring only work practices at disposal sites and elimination of no visible emissions as compliance option, (2) requiring cover before compaction, (3) requiring enclosed/covered waste transport vehicles, (4) requiring certain procedures to be followed for decontamination of vehicles, (5) regulating all inactive sites, and (5) developing regulations for the import and export of asbestos waste.

SLIDE 14

Revisions that are being considered for the spraying, insulation, and roadways portions of the asbestos NESHAP are: (1) prohibit spraying of any material containing more than 1% asbestos, (2) prohibit the use of all insulation containing more than 1% asbestos, and (3) control removal and recycling of pavement containing more than 1% asbestos.

**REVISIONS UNDER CONSIDERATION
(WASTE DISPOSAL)
(CONTINUED)**

- **REQUIRE WORK PRACTICES, ELIMINATE NO VE AS A COMPLIANCE OPTION**
- **COVER BEFORE COMPACTION**
- **ENCLOSED/COVERED WASTE TRANSPORT VEHICLES**
- **VEHICLE DECONTAMINATION**
- **REGULATE ALL INACTIVE SITES**
- **IMPORT/EXPORT OF ASBESTOS WASTE**

**REVISIONS UNDER CONSIDERATION
(SPRAYING, INSULATION AND ROADWAYS)**

- **PROHIBIT SPRAYING OF ANY MATERIAL CONTAINING MORE THAN 1% ASBESTOS**
- **PROHIBIT USE OF ALL INSULATION CONTAINING MORE THAN 1% ASBESTOS**
- **CONTROL REMOVAL AND RECYCLING OF PAVEMENT CONTAINING MORE THAN 1% ASBESTOS**

As I have previously mentioned, this study is not yet completed and additional work is continuing. None of the revisions and options have been selected at this time. We have developed some information on revisions and options regarding impacts and some of these impacts are presented for your information.

SLIDE 15

The preliminary impact estimates for requiring the use of HEPA filters after currently required control devices for all gas streams would have a model plant cost that would range from \$5,700 to \$1.6 million with an estimated emission reduction of 1,000 kg per year. The cost range is due to the number of emission streams that would have to be controlled at a plant.

SLIDE 16

The preliminary impact estimates for deleting the quantity cutoff from the demolition and renovation regulation are a model plant cost of \$1,700 per year with an average increase in the demolition costs of 220% and a national cost of \$38 million per year. The average price increase for private structure services would be about 0.1% (This is the increase in rent that the building owner would have to charge to cover costs.) The present value cost to demolish public structures is a onetime cost of \$1.40 per household. The emissions reductions of asbestos fibers

PRELIMINARY IMPACT ESTIMATES FOR MILLING, MANUFACTURING, AND FABRICATING

- HEPA Filters After Currently
Required Control Devices Revision

-- HEPA Filters Option
(For all gas exhaust streams)

Model Plant Cost (\$10 ³ /yr):	5.7 - 1,600.0
Emission Reduction (kg/yr)	1,000

PRELIMINARY IMPACT ESTIMATES FOR DEMOLITION AND RENOVATION

- Reduce Quantity Cutoff Revision *

-- Delete Quantity Cutoff Option

Model Plant Cost (\$10 ³ /yr):	1.7
Average Increase in Demolition Costs (%):	220
National Cost (\$10 ⁶ /yr):	38
Average Price Increase for Private Structure Services (%):	0.1
Present Value Cost to Demolish Public Structures (\$/Household):	1.40
Emission Reduction (kg/yr):	5

*

Renovations are included in the baseline and are not impacted

to the outside air is estimated at 5 kilograms per year. These costs would only impact demolitions since renovations are included in the baseline and are not impacted.

SLIDE 17

The preliminary impact estimates for the required use of negative pressure/HEPA filter systems for the demolition and renovations of buildings would result in model building costs which would range from \$200 to \$1.3 million depending on the size of the building and would increase the demolition costs by an average of 8.1% with a resulting national cost of \$140 million per year. The average increase in private structure services would be nil and the onetime present value cost to demolish public structures would be approximately \$4.90 per household. The estimated emission reductions of asbestos fibers to the outside air would be approximately 600 kilograms per year. Renovations are included in the baseline and are not impacted. The analysis assumes that the threshold has been deleted.

SLIDE 18

The preliminary impact estimates for requiring the final thickness of cover of 36 inches for inactive waste disposal sites would range from \$200 to \$2,000 per year for landfills with a national cost of about \$2 million per year.

PRELIMINARY IMPACT ESTIMATES FOR DEMOLITION AND RENOVATION (Continued)

- Negative Pressure/HEPA Filter System Revision *

-- Require for Demolition and Renovation Option

Model Plant Costs (\$10 ³ /yr):	0.2-1300
Average Increase in Demolition Costs (%):	8.1
National Cost (\$10 ⁶ /yr):	140
Average Price Increase for Private Structure Service (%):	0
Present Value Cost to Demolish Public Structures (\$/Household):	4.90
Emission Reduction (kg/yr):	600

*

Renovations are included in the baseline and are not impacted.
Analysis assumes threshold has been deleted.

PRELIMINARY IMPACT ESTIMATES FOR WASTE DISPOSAL

- Final Thickness of Cover Revision

-- 36 Inch Final Cover Option

Model Plant Cost ($\$10^3/\text{yr}$):

0.2-2.0

National Cost ($\$10^6/\text{yr}$):

2.0

-- Variable Depth Based on Frost Penetration Option^{*}

Model Plant Costs ($\$10^3/\text{yr}$):

0.1-6.1

National Cost ($\$10^6/\text{yr}$):

1.00

One-time Present Value Cost for

Final Cover: (\$/State Citizen)

1.50

* One-time cost from public landfills only impacts residents of northern States affected by variable depth option

The preliminary impact estimates of the variable depth of cover (based on frost penetration) for inactive waste disposal sites would result in a cost per year ranging from \$100 to \$6,100 and a national cost of about \$1 million. The onetime present value cost would be \$1.50 per State citizen. The impacts of the variable depth of cover option would only affect the residents of certain northern States.

SLIDE 19

As I have mentioned previously, our analysis of all the revisions and options are not completed at this time. This briefing presented the information that we have developed thus far and was presented for your information. The project schedule calls for developing a first draft of the technical information and costs which would be sent for outside review in March or April of 1991. We project that the revisions would be prepared in April of 1992 and promulgated in May of 1993.

This concludes the status briefing for the Asbestos NESHAP revision.

PROJECT SCHEDULE

- **SEND OUTSIDE EPA FOR REVIEW**
 - **MARCH 91**
- **PROPOSAL**
 - **APRIL 92**
- **PROMULGATION**
 - **MAY 93**

DISCUSSION

Following the EPA presentation, Ms. Vivian McIntire of the Committee commented that she was concerned at the high cost versus benefit of some of the options and expressed hope that EPA would carefully consider what is gained versus cost. Mr. Sims Roy of EPA responded that at this time, the information gathered to date was being presented and that no decisions had been made on which options were being being selected for proposal. He noted that once EPA had completed its analysis of the options, a background information document containing the analysis would be distributed for review to groups outside EPA. Mr. Roy also commented that the emission reductions, reported as kg/yr seemed small in terms of weight, but represented a lot of asbestos fibers.

Mr. William O'Sullivan of the Committee asked where is the asbestos asphalt a problem and noted that more asphalt pavement was being recycled. Mr. Roy responded by saying that EPA would not necessarily prevent recycling asbestos asphalt but was interested in controlling any emissions during its removal. It was noted that most of the asbestos asphalt was believed to to have been used in specialty applications such as overlays on bridges and airport runways.

Mr. Paul Arbesman of the Committee questioned the development of more rules that would apply to the asbestos industry when the industry is already declining and EPA's ban and phasedown rule have mandated its closure. Mr. Roy noted that the analysis of options

that apply to the asbestos industry will take into account the fact that the industry is rapidly declining and will be phased out by 1996. He noted, however, that the ban and phasedown rule does not apply to all sources and that the sources remaining after the ban and phasedown were also being examined.

Mr. Arbesman also asked if the negative pressure and HEPA filter option for demolition and renovation would apply only to friable asbestos? Mr. Roy stated that the requirement would apply to materials subject to the NESHAP.

Dr. Patrick Atkins of the Committee noted that epidemiological studies of workers at the Thetford Mine in Canada showed no health effects at their exposure level. He asked what does EPA have in the way of health effects data in support of a more stringent NESHAP? Mr. Jim Weigold responded by noting that differential impacts based on epidemiological studies were difficult to determine. He noted that the CAA amendments listed asbestos as one of the compounds to be regulated and that, at least initially, standards must be technology based, rather than risk based.

Mr. Charles Collins of the Committee commented that there were many regulations that applied to asbestos and suggested updating the regulation to require what is already being done.

Mr. William Dennison of the Committee observed that in many instances it was probably better to leave the asbestos in place rather than removing it. Mr. Roy noted that the asbestos NESHAP would not require seeking and removal of asbestos.

Other Presentations and Discussion

Mr. Joey Toney, California Asbestos Monofill, made a

presentation concerned with the disposal of asbestos waste. Following his presentation, Ms. Vivian McIntire commented that if the current asbestos NESHAP was complied with, it is likely that there would not be the need for more sophisticated requirements. Mr. Paul Arbesman asked how long would it take to fill the former asbestos mine now being used as an asbestos waste disposal site? Mr. Toney stated that the site would hold about 16 million cubic yards and would take about 25 years to fill. Mr. Patrick Atkins asked what was the fate of the asbestos tailings? Mr. Toney stated that the tailings from the previous milling operation were being used to cover the asbestos waste. Mr. John Pinkerton of the Committee inquired as to the cost of disposing of asbestos waste at the facility. Mr. Toney stated that they charged \$30 per cubic yard. Fees for asbestos waste in California ranged from \$15 per cubic yard to \$100 per cubic yard for Class I sites.

Mr. John Welsh, Safe Building Alliance, addressed the Committee and asked EPA to consider delaying the rulemaking until the ongoing rulemakings of other agencies, such as OSHA, are complete. Mr. Roy noted that EPA was working with OSHA and OTS to coordinate asbestos rulemaking efforts. He also noted that under the NESHAP, EPA does not require removal of asbestos. In response to the observation that there appears to be small emission reduction potential associated with some options, Mr. Roy noted that a few kilograms of asbestos amounts to a lot of asbestos fibers. Regarding the report that will eventually come from the Health Effects Institute, Mr. Roy indicated that EPA is interested in its conclusions and will take them into account when evaluating

residual risk after applying MACT/GACT controls, but that the current rulemaking is technology-based.



January 29, 1991

United States Environmental Protection Agency
NAPCTAC Committee Members
Research Triangle Park, NC 27711

RE: Comments respecting, "Comprehensive Asbestos NESHAP Revisions--Information for NAPCTAC." Maximum Achievable Control Technology (MACT) for asbestos waste disposal.

NAPCTAC Committee Members:

During the period 1975 through 1987 my company operated the nations largest asbestos mining and milling facility. Ore reserves at the mine were depleted at the end of 1987 and the mine closed. Our mine reclamation plan called for use of the open pit as a landfill, the disposal of asbestos-containing waste (ACW) seemed a logical second use for the mine pit. Knowing mine closure was eminent, we undertook what proved to be an alarming two year study of asbestos fiber dust generation sources at existing ACW disposal sites. Our concept was to develop the state-of-the-art ACW disposal facility in the country.

The EPA has identified the disposal of ACW as the largest remaining source of ambient asbestos emissions (227,000 kg/yr), during our study of the industry we found this to be precisely the case. Asbestos fiber dust release was and is a wide spread problem at ACW landfills. We identified the major dust sources associated with ACW disposal and later through the use of engineering controls or work practices eliminated those sources in the design of our facility.

We visited several typical ACW landfills and identified the following specific problems as significant sources of ambient asbestos fiber emissions and resulting human exposure to asbestos.

1. Improperly packaged ACW or broken bags of ACW inside the delivery vehicle cargo box. These conditions result in asbestos emissions when the ACW is dumped into the landfill cell.
2. Bags of ACW that are dry or contain excessive air. Both of these conditions often result in asbestos emissions during disposal operations via bag rupture.
3. Residual ACW remaining in delivery vehicle box after off loading is completed.

4. Minimal or nonexistent use of personal protective equipment by landfill employees. Often the truck driver is required to off-load his delivery at the landfill cell without personal protective equipment.
5. Insufficient cover material or a complete lack of cover material deposited over the ACW prior to compaction by mobile equipment. This practice results in bag rupture.
6. Obvious lack of proper asbestos work practices among landfill employees resulting in both employee exposure and asbestos fiber release to the ambient air.
7. The commingling of ACW with other landfill waste streams which threatens the integrity of the bags and increases the odds for future remediation of the site.
8. A total lack of asbestos sampling for both employee exposure as well ambient fiber release.

All of these identified deficiencies were considered in the development and design of California Asbestos Monofill, Inc. (CAM). The idea behind CAM was and is to provide for safe and efficient disposal of ACW without any threat to the environment or human health. The following engineering controls and or work practices were instituted at CAM, they have proven effective in eliminating the above described emission sources and currently represent MACT and for ACW disposal. All engineering controls and work practices developed at CAM can be easily implemented at any other landfill:

HEPA FILTERED INSPECTION AND RECEIVING STATION

Eliminates problems No. 1 and 2.

CAM designed and built a HEPA filtered negative air receiving and inspection station. The main function of the receiving station is to provide a protected environment within which to inspect the incoming loads of ACW. Utilization of the receiving station provides an opportunity to identify and correct problems in the load such as loose or non-bagged ACW, dry ACW or bags with excessive air. Correction of these conditions, i. e., bagging loose ACW, wetting dry ACW and evacuating excessive air with HEPA vacuums, within the protected environment prevents later ambient asbestos emissions upon dumping.

In addition to visual inspection, testing is conducted within the receiving station to insure that only inert ACW is received. Testing is accomplished utilizing a hand held photo ionization detector to screen the ACW bags. This inspection process is conducted for every incoming load of ACW, it can be performed by one worker and takes about ten minutes per truck.

All employees working inside the receiving station wear whole body covering and PAPRs.

DELIVERY TRUCK CLEANING

Eliminates problem No. 3.

Loose ACW inside the cargo area of the delivery truck, particularly asbestos containing water, is a significant source of residual exposure to asbestos. Any loose ACW found during inspection can be properly wetted and packaged inside the protected receiving station and should not cause a problem upon disposal. Asbestos contaminated water, however, can and does create an unexpected problem.

Puddles of water can easily be absorbed and bagged inside the receiving station but the residue is still present after dumping. If allowed to dry, the asbestos can become airborne creating an exposure problem down stream of the landfill. For this reason ACW delivery vehicles are either HEPA vacuumed or pressure washed prior to leaving CAM. Pressure washing is preferred as it has the best cleaning action and the resulting asbestos contaminated water can be cleaned via a simple settling/filtration pond. Additionally, all box liners and tape and any other debris must be removed from the box. CAM has used this box cleaning system for five months and it has performed well. Box cleaning also prevents cross contamination if back hauling is contemplated.

ACCESS CONTROL

Eliminates problem No. 4.

In most cases, incoming trucks drop their boxes at the receiving station, pick up previously emptied and cleaned boxes and, after inspection, leave the site. CAM employees then load the full boxes onto a CAM truck and deliver the material to the disposal site for off loading and disposal by CAM employees. After disposal has been completed, the empty box is then returned to the receiving station for cleaning via HEPA vacuuming or pressure washing. The cleaned box is then returned to the ready line.

Occasionally a delivery truck arrives that is not compatible with CAM equipment. In such a case the driver is provided with whole body covering and respiratory protective equipment, a CAM employee accompanies the driver to the disposal cell where CAM employees off load the ACW. The remainder of the procedure is the same.

DISPOSAL PROCEDURES

Eliminates problem No. 5.

Once the ACW has been inspected and accepted by CAM, the ACW is delivered to the landfill for disposal. There are two key elements in CAM's disposal procedure which eliminate the potential for fugitive emissions at the landfill. The first is the application of amended water (water to which a wetting agent has been added) to the ACW and the cover material before the ACW is covered and compacted. This is accomplished via large irrigation type sprinklers. The application of the amended water provides added protection should an ACW bag tear or rupture during compaction. The second element is the requirement of a minimum of one foot of cover placed over the ACW prior to compaction. CAM has found through experience that one foot is the minimum required cover to prevent inadvertent contact of the ACW by the landfill machines, two feet is best.

EMPLOYEE TRAINING

Eliminates problem No. 6.

Employee training can not be stressed to strongly. Flawlessly designed engineering controls can be rendered useless if proper work procedures are not followed. Current mandated training should be considered a minimum requirement. In addition to training required under the various regulations, CAM sends all employees to the 40 hour AHERA "Practices and Procedures in Asbestos Control" class as well as a site specific procedures class. Understanding the health hazards presented by asbestos as well how to protect himself, his fellow workers and the public is imperative for asbestos landfill workers. Most asbestos landfills are located near population centers and most disposal work occurs outdoors, therefore, ambient asbestos emissions from landfills potentially expose large numbers of people. The AHERA "Procedures" class as well as site specific training should be required for all asbestos landfill employees at least annually.

ASBESTOS MONOFILL

Eliminates problem No.7.

The vast majority of ACW is inert except for the asbestos itself which does not migrate in soil nor create leachate. Typical constituents of ACW are wood, plastic, sheet rock, fiberglass, disposal work suits, respirator cartridges etc.

Inert ACW should not be commingled with other waste streams which can and do create environmental problems. Sites that commingle

inert ACW with other wastes may be required to re-excavate the ACW while performing remediation of the site at some later date thereby creating the possibility for the asbestos to become airborne. In addition, commingling ACW with other materials threatens the integrity of the ACW bags.

ACW should be disposed in monofills only. There are several asbestos monofills operating in the U.S. and multiple waste landfills which have separate cells for ACW. The rare case where ACW contains other hazardous materials is easily detected during the inspection procedure.

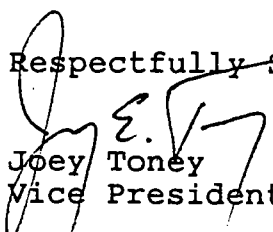
AIR SAMPLING

Eliminates problem No. 8.

Anytime asbestos is handled air sampling should be conducted. It is not possible to detect the majority of ambient asbestos emissions with the unaided eye. The fibers are simply too small. Air sampling is the only way to accurately determine whether or not fibers are being released. Sampling is virtually non-existent at most ACW landfills. CAM conducts both area and personal samples (PCM) as well as upwind and downwind property boundary samples (TEM) on a regular schedule. To date, with the above described engineering and work practice controls in place, all asbestos in air test results at CAM have been well below the lower detection limit of the analytical method employed. At a minimum, sampling for asbestos in air should be conducted at the current working area of all active ACW landfills at least once per week. Such a requirement would provide an actual data base from which to judge the effectiveness of existing controls as well as the need for additional controls.

These practices and engineering controls when added to the existing NESHAPS will indeed reduce asbestos fiber emissions from ACW disposal operations to the lowest feasible level. These engineering and work practice controls are readily available to all ACW landfills and are relatively inexpensive. I urge you to recognize these controls by incorporating them into NESHAPS as MACT for ACW disposal.

Respectfully Submitted,


Joey Toney
Vice President, Operations

EPA.TXT

**MEETING OF THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY'S
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE
(NAPCTAC)**

**ON THE DEVELOPMENT OF PROPOSED REVISIONS
TO THE NATIONAL EMISSIONS STANDARDS FOR ASBESTOS**

COMMENTS OF THE SAFE BUILDINGS ALLIANCE

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NAPCTAC COMMENTS OF THE SAFE BUILDINGS ALLIANCE

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I. INTRODUCTION

The Safe Buildings Alliance (SBA) is an association of leading building product companies that formerly manufactured asbestos-containing materials (ACM). SBA's membership includes United States Gypsum Company, The Celotex Corporation, Keene Corporation, and W.R. Grace & Co. We appreciate the opportunity to make this presentation to EPA's National Air Pollution Control Techniques Advisory Committee (NAPCTAC) on the subject of comprehensive revisions to the national emissions standard for asbestos (NESHAP).¹

Since its formation in 1984, SBA has worked with federal, state, and local governments in support of programs assuring objective responses to ACM in buildings, and has consistently supported legislation that will result in scientifically-based standards. SBA has participated in past emission standards development (including EPA's most recent NESHAP revisions),² the asbestos-in-schools (AHERA) regulatory negotiations, EPA's Policy Dialogue on Public and Commercial Buildings,³ and other local and state activities addressing asbestos in building issues.

SBA's comments today will focus on why EPA should not at this time substantially expand requirements of its asbestos NESHAP. In particular, we address why such expansions will neither further the Clean Air Act's overriding goal of adequately protecting public health, nor result in requirements appropriately keyed to the Clean Air Act Amendments of 1990.⁴ In addition, we also explain why revising the NESHAPs at this time will not

achieve the Agency's self-imposed goal of "mak[ing] the provisions and language of the asbestos NESHAP compatible with other regulations on asbestos promulgated."⁵

We conclude that neither statutory goals nor interagency coordinative ends are furthered by initiating NESHAP revisions at this time. First, we believe that additional information soon available from the Health Effects Institute-Asbestos Research (HEI-AR) project, the Occupational Safety and Health Administration (OSHA) rulemaking,⁶ and EPA's Office of Toxic Substances regulatory activities will provide knowledge vital to determining the necessity and scope of any NESHAP revision.

Second, EPA's most recent NESHAP revision, barely two months old, sufficiently ensures more than adequate public health protection.⁷ When the reductions in asbestos emissions that will be achieved by full compliance with the present NESHAP are compared to emission reductions predicted for potential NESHAPs revisions, it appears that vigorous enforcement of the present NESHAPs is the most effective and economical way of reducing asbestos emissions. In short, given the public health protection that full compliance with the present NESHAPs offers, and the ability of soon-to-be-available information to assist EPA and NAPCTAC in their revision decision, the prudent action for EPA at this time is to refrain from deciding whether to revise the asbestos NESHAP. When the pending HEI-AR scientific reviews/research and ongoing OSHA and EPA rulemaking activity are completed, the Agency will be able to use this information to ensure that statutory intentions are met, that new Clean Air Act

Amendments requirements are addressed, and that interagency harmony problems are resolved.

II. NEW SCIENTIFIC REVIEW AND RESEARCH, FEDERAL AGENCY POLICY REVIEW, AND RECENT FEDERAL REGULATORY ACTIVITY WILL PROVIDE EPA AND NAPCTAC WITH VITAL INFORMATION IN DETERMINING WHETHER SUBSTANTIAL NESHAQ REVISIONS ARE WARRANTED.

A. The Health Effects Institute's Literature Review and Independent Exposure/Control Research.

In order for NAPCTAC and EPA to make an appropriate determination of whether present standards effectively control asbestos emissions and thus ensure public health safety, they should consider the extent to which asbestos in buildings poses a human health hazard and whether present or proposed actions calling for additional asbestos disturbance will reduce such hazards. Congress has commissioned substantial independent research by the Health Effects Institute-Asbestos Research (HEI-AR) to "determine actual airborne exposure levels prevalent in buildings . . . characterize peak exposure episodes and their significance, and . . . evaluate the effectiveness of asbestos management and abatement strategies."⁸ HEI-AR has already presented some of its findings, concluding that "from the exposure studies to date, it is clear that exposure to asbestos in asbestos-containing buildings is normally extraordinary low" and that "removal of asbestos-containing materials . . . may often, some though typically, actually increase exposure and therefore risk, for all building occupants."⁹

HEI-AR is continuing to review the scientific literature and data on asbestos exposure levels in buildings and is conducting additional asbestos exposure studies.¹⁰ This research, jointly funded by the federal government and private parties, including current and former product manufacturers, realtors, developers, building owners and managers, mortgage bankers and the insurance industry, will consist of a thorough literature review (which should be released this Spring), comprehensive research on episodic exposures, and additional study on prevailing exposures (which will be completed within the next two years).

HEI-AR's research thus far has led EPA in other contexts to question its policies on asbestos disturbances and removals;¹¹ this additional exposure research and literature review should prove very useful to EPA and NAPCTAC in determining the extent to which NESHAPs should require disturbance and removal of ACM in renovation and demolition.

E. Recent and Pending Federal Regulatory Activities.

1. EPA's Activities Updating Appropriate Asbestos Control Strategies.

In addition to its substantial commitment to HEI-AR research programs, Administrator Reilly recently stated that "EPA is taking a number of steps to clarify the degree of risk posed by asbestos, and also to reinforce our guidance on appropriate response strategies."¹² These efforts, already concluded or well underway, will assist NAPCTAC and EPA in determining the prudence

of further NESHAP revisions. EPA's examination of and additions to its regulatory programs include:

a. EPA's Evaluation of the Asbestos-in-Schools Program.

EPA is currently in the process of thoroughly evaluating its asbestos-in-schools program, AHERA, "to determine how effective it has been for schools and what aspects of it, if any, may be appropriate for public and commercial buildings."¹³ This review, undertaken by an outside contractor, Westat, will be available in March 1991; it will scrutinize the efficacy of AHERA inspections, training, responsive actions and management plans in reducing exposures to school occupants. Id. Because many aspects of AHERA overlap with contemplated or present NESHAP requirements,¹⁴ EPA's critique of its AHERA program should provide NAPCTAC and EPA with insight into whether AHERA has been successful in achieving a reduction in emissions; whether future buildings asbestos control policies such as NESHAPs should be modeled on AHERA requirements; whether AHERA's requirements, in some cases, lead to unnecessary asbestos removals; and whether asbestos emissions reduction programs should shift their focus to more effective methods of reducing exposures (i.e., in-place management).

b. EPA's Policy Dialogue.

In Spring 1990, EPA held a series of public hearings to address whether rulemaking would be necessary to further reduce asbestos exposures in public and commercial buildings. EPA

published the final report on the culmination of the discussions in June 1990 -- "The Asbestos in Public and Commercial Buildings Policy Dialogue."¹⁵ Although EPA is still considering several Dialogue issues, the Dialogue demonstrated a general agreement among private parties such as realty interests, manufacturers, public interests groups, unions and insurers that one appropriate policy objective is "avoiding pressures for removals that are a result of . . . misunderstanding about the risks of asbestos in buildings and the ability to effectively manage asbestos in place."¹⁶

Despite the results of the Dialogue, EPA has recently indicated that it can make a definitive determination on whether such a rulemaking is warranted only after it receives the results of the pending OSHA rulemaking (see Section II.B.2, infra), the results of the AHERA evaluation (see Section II.B.1.a, supra), and the results of the HEI-AR literature review (see Section II.A, supra).¹⁷ These pending results will show whether ACM in good condition should be disturbed, and if so, what measures are appropriate to ensure that such disturbance does not amplify prevailing exposure levels.

The Dialogue showed that many groups are concerned that removal is sometimes unnecessarily advocated -- often to the detriment of public health. But, as EPA decided, it alone is insufficient to determine whether rulemaking is warranted. However, to the extent that the present or proposed NESHAP requirements overtly or covertly advocate unnecessary removals,

EPA and NAPCTAC should carefully consider the Dialogue's concerns and respond so that no NESHAP requirement "pressures for removals" as a result of misunderstanding about asbestos exposures.

c. New EPA Rules on Training of Workers.

Recently, the Asbestos School Hazard Abatement Act was reauthorized, amending the AHERA program to add training and accreditation requirements for abatement workers in all types of public and commercial buildings.¹⁸ This is the first extension of AHERA to non-school settings, and will require all abatement workers in all types of buildings to be trained and accredited in accordance with current AHERA requirements. This expansion of AHERA, in conjunction with OSHA's proposed training requirements (see Section II.B.2, infra), will more than adequately ensure that all workers in buildings with ACM are sufficiently trained.

The Comprehensive Revisions Report presently proposes additional training requirements as part of the NESHAPs revisions.¹⁹ The report also notes that its proposal merits reassessment upon AHERA's amendment, if such amendments provide for appropriate training. Since AHERA has been amended to provide for training, and because OSHA will also require additional worker training, SBA urges EPA to carefully consider the negative effect of duplicative requirements, and refrain from adding training to the NESHAPs.

2. OSHA's Current Rulemaking.

Vital information for this EPA rulemaking will result from the record now being developed in response to the current

rule proposed by OSHA.²⁰ The rule proposes expanded notification requirements and increased protections for people working directly with asbestos and for bystanders. OSHA's proposals: (1) establish a new permissible exposure limit ("PEL") of 0.1 f/cc; (2) amplify building owner and employer reporting and information transfer requirements; (3) extend the competent person supervisory requirement to all construction operations, including those of small-scale, short-duration; (4) provide more narrow definition for and exemptions pursuant to small-scale, short-duration operations; and (5) extend negative-pressure enclosure requirements to additional asbestos-related operations.

The issues raised in OSHA's rulemaking significantly overlap with present and proposed NESHAP requirements for demolition and renovations. For instance, OSHA's present standards require certain protective actions based upon the magnitude of ACM disturbing activity.²¹ In OSHA's current rulemaking, the Agency may change both the threshold definitions of activity magnitude as well as protections required for such activities.²² OSHA's analysis will be useful to EPA in its determination of whether to reduce the NESHAP threshold.²³ OSHA's present negative pressure enclosure requirements, currently subject to new rulemaking, overlap substantially with the Comprehensive Revisions Report's proposed NESHAPs for negative pressure requirements for renovations.²⁴ Similarly, proposed NESHAP training requirements for asbestos inspectors and workers are also covered by OSHA, which requires competent person training.²⁵ Finally, the Comprehensive Revisions Report also suggests requiring

inspections of all buildings for ACM; OSHA is presently considering a similar requirement in its current rulemaking.²⁶

Although OSHA regulations are ostensibly directed towards workers, those workers protected also include bystander employees (those in the vicinity of ACM-disturbing activities). By protecting bystander employees from significant risk, OSHA's requirements, by definition, provide protection to individuals even further away from the ACM activity -- those bystanders in the vicinity. This latter group is the "public" that EPA is charged with protecting with its NESHAP requirements.

Because of the overlap between OSHA and EPA NESHAPs in both regulatory coverage (bystanders) and issues addressed in present and proposed rules, we urge NAPCTAC and EPA to refrain from additional NESHAP rulemaking at this time. Upon completion of the OSHA rulemaking (reasonably expected in the first half of 1992), EPA and NAPCTAC will be able to make full use of OSHA's rulemaking record in its decision on whether to proceed with NESHAP revisions and, equally important, the specific revisions that are needed.

III. EPA'S PROPOSED REVISIONS ARE PREMATURE

A. NESHAP Revisions Are Not Required at This Time to Protect Public Health.

In the recent "clarifying revisions" to the asbestos NESHAP, EPA recognized that "when complied with, the asbestos NESHAP is effective in reducing emissions and protecting the public health."²⁷ EPA noted that its actual problem was lack of

enforcement. Thus, additional revisions are not needed to make NESHAPs effective -- vigorous enforcement is.

In addition, according to the Comprehensive Revisions Report, the regulatory revisions under consideration, even if promulgated today, would do little to significantly reduce emissions of asbestos.²⁸ Derivatively, such changes would do little to advance public health. Thus, compared to the actual reductions that could be achieved simply by ensuring compliance through vigorous enforcement, the potential substantial revisions to the asbestos NESHAP are in fact of little use. EPA should therefore focus its limited resources on compliance with its present NESHAP, in order to ensure that emissions are reduced and public health is protected.

B. EPA Cannot Achieve All of its Goals with a Revision Decision at This Time.

Any proposed NESHAP revisions must achieve many goals. First, as stated in the Comprehensive Revisions Report, suggested changes would expand the scope and increase the NESHAPs stringency.²⁹ Under the new provisions of the Clean Air Act, such new revisions must consider maximum achievable control technology (MACT) and generally available control technology (GACT).³⁰ Second, any NESHAP revisions must conform with the general Clean Air Act statutory duty to protect public health. Finally, the Comprehensive Revisions Report states that the intent of the revisions is to make the asbestos NESHAP provisions compatible with other federal regulations, such as OSHA worker protective regulations, EPA regulations under TSCA and AHERA, and Department

of Transportation requirements.³¹ None of these goals can be met given EPA's current lack of information and the extensive regulatory and other activities concerning asbestos now underway. EPA and NAPCTAC should therefore refrain from revision decisions, acting in the most health protective way possible until adequate information is available.

C. NESHAP Revisions at This Time Would Constitute a Waste of Agency Resources.

Apart from the lack of the new data which the HEI Study, the OSHA rulemaking, and other activities will produce, proceeding with this revision now would also involve efforts by EPA that will be duplicative of work that will be going on at the same time in connection with the OSHA rulemaking, the HEI-AR research, the AHERA examination, and GAO's investigations.

In addition, if a new NESHAP rule results, there likely will be major costs to comply with this revised regulation. The results of HEI's work could show that some or all of these costs are unnecessary. One of EPA's statutory mandates is to consider the cost of achieving emission reduction.³² If emissions reductions will not be achieved by the revisions, or if the costs are unjustifiably high compared to the benefits, EPA will not have met its statutory edict. Further, spending Agency resources on a substantial regulation revision now reduces the likelihood that a substantial regulation revision will be commenced after additional information is received, at a more appropriate time for EPA to act if needed to protect the public health.

D. EPA Is Unable to Properly Consider the Suggested NESHAP Revisions Options.

As stated in Section II, supra, SBA urges that EPA and NAPCTAC refrain from further revisions pending upcoming additional information on asbestos. In addition to the practical reasons for proceeding only upon availability of the information cited in Section II, there is evidence in the Comprehensive Revisions Report itself, as cited below, providing additional support that such restraint is intended by the report's authors.

The report provides regulatory revision options premised on present or proposed OSHA standards. For example, one threshold option supplied by the report suggests keying NESHAPs requirements to OSHA's definition of small-scale, short-duration operations.³³ Such an option will only be possible upon OSHA's completion of its present rulemaking, where the definition of small-scale, short-duration operations is being revised. As a practical matter, the NESHAP revisions cannot be premised on standards that have yet to be promulgated. Similarly, the report suggests requiring building inspections as part of new NESHAPs.³⁴ OSHA is addressing this precise issue in its current rulemaking; the OSHA record should provide EPA with a substantial advantage in addressing the usefulness of inspections. Once OSHA has issued its final rule, expected in the first half of 1992, it would be appropriate for EPA to determine if NESHAP revisions are warranted. This is especially the case if the Agency is serious about coordinating its requirements with other federal asbestos programs.

IV. CONCLUSION

EPA's overriding goal in promulgating NESHAP revisions is to adequately protect public health. EPA must also key any new NESHAPs to Clean Air Act 1990 Amendment provisions. Finally, the Agency has set for itself a goal of coordinating the NESHAPs with other federal asbestos programs. SBA fully supports EPA's efforts to achieve these ends. We believe, however, that such ends cannot be achieved at this time because of lack of information. This information will be available in the future and will assist the Agency in its decision making efforts. Until such information is available, we urge EPA to refrain from deciding whether to revise the NESHAPs. In the interim, we suggest that EPA focus its attention on enforcing its present NESHAPs, which adequately protects public health.

ENDNOTES

1. See EPA, Emissions Standard Division Office of Air Quality Planning and Standards, Comprehensive Revisions to the Asbestos NESHP -- Information for NAPCTAC (Jan. 1991) (hereinafter "Comprehensive Revisions Report").

2. See EPA, Final Rule, National Emission Standards for Hazardous Air Pollutants; Asbestos NESHP Revision, 55 Fed. Reg. 48406 (Nov. 20, 1990); and SBA's Comments, In re Asbestos National Emissions Standards for Hazardous Air Pollutants, Notice of Proposed Rule Revision (Mar. 7, 1989).

3. See EPA, Policy Dialogue: Asbestos in Public and Commercial Buildings, Final Report (June 15, 1990).

4. See 42 U.S.C.A. § 7401(b)(1) (1983); see also Clean Air Act Amendments of 1990, Pub. L. No. 101-549, § 301(d)(2), 104 Stat. 2399, 2539 (1990); H.R. Conf. Rep. No. 952, 101st Cong., 2d Sess. at 147 (1990).

5. EPA, Comprehensive Revisions Report, ftnt. 1, supra, at III-1.

6. See OSHA, Notice of Proposed Rulemaking for Occupational Exposure to Asbestos, Tremolite, Anthophyllite and Actinolite, 55 Fed. Reg. 29712 (July 20, 1990).

7. See ftnt. 2, supra, EPA, 55 Fed. Reg. 48406.

8. H.R. Rep. No. 701, 100th Cong., 2d Sess. 2 (1988).

9. Health Effects Institute, Asbestos Study Team Final Report (Mar. 1989).

10. Id.; Reilly, W., Environmental Protection Agency, Asbestos, Sound Science, and Public Perceptions: Why We Need a New Approach to Risk, presented at American Enterprise Institute Environmental Policy Conference (June 12, 1990).

11. See for example, EPA, "Managing Asbestos in Place - a Building Owner's Guide to Operations and Maintenance for Asbestos-Containing Materials" (1990).

12. See ftnt. 10, supra, Reilly, at 6. In addition to other agency activity described in Section II.B, the General Accounting Office (GAO) is investigating both AHERA accreditation and training of abatement personnel, and EPA's asbestos and disposal programs. See Asbestos Studies in Works at General Accounting Office, [Jan. - June] Asbestos Abatement Report (BNA) at 5 (Jan. 18, 1991).

13. See ftnt. 10, supra, Reilly, at 6; Report on Results of AHERA said Due from EPA in March, [Jan. - June] Asbestos Abatement Report (BNA) at 4 (Jan. 7, 1991).

14. See for example, Comprehensive Revisions Report at ftnt. 1, supra, at VIII-12 (training), VIII-6 (inspections and management plans).

15. See ftnt. 3, supra.

16. Id. at 7.

17. See letter from L. Fisher, EPA, to O. Baird, Service Employees International Union, dated Nov. 14, 1990. See also Service Employees International Union v. USEPA, Dkt. No. 89-0851.

18. See ASHAA Renewal Bill Signed; Law Requires Accreditation, [July-Dec.] Asbestos Abatement Report (BNA) at 3 (Dec. 10, 1990).

19. See EPA, Comprehensive Revisions Report, ftnt. 1, supra, at VIII-12 to 13.

20. See ftnt. 6, supra.

21. See 29 C.F.R. § 1926.58 Appendix G.

22. See ftnt. 6, supra, OSHA, 55 Fed. Reg. at 29752.

23. See Comprehensive Revisions Report, ftnt. 1, supra, at VIII-3.

24. Id. at VIII-4; see also 29 C.F.R. § 1926.58(e)(6); ftnt. 6, supra, OSHA, 55 Fed. Reg. at 29752.

25. Comprehensive Revisions Report, ftnt. 1, supra, at VIII-12 to 13; see also 29 C.F.R. § 1926.58(e)(6)(iii); ftnt. 6, supra, OSHA, 55 Fed. Reg. at 29726-29729.

26. Comprehensive Revisions Report, ftnt. 1, supra at VIII-6; ftnt. 6, supra, OSHA, 55 Fed. Reg. at 29730.

27. EPA, Notice of Proposed Rule Revision for Asbestos NESHAP, 54 Fed. Reg. at 912 (Jan. 10, 1989).

28. See Comprehensive Revisions Report, ftnt. 1, supra, at VIII-4 (emissions reduction for various options of 5 kg/yr.); VIII-6 (no actual emissions reductions estimate, but expected to be "small"); VII-7 (no actual emissions reduction expected).

29. See, Comprehensive Revisions Report, ftnt. 1, supra at III-1.

30. See ftnt. 4, supra.

31. See Comprehensive Revisions Report, ftnt. 1, supra, at III-1.

32.See ftnt. 4, supra.

33.See, Comprehensive Revisions Report, ftnt. 1, supra at VIII-3.

34.Id. at VIII-6.

XII. MUNICIPAL WASTE COMBUSTORS -
STATUS REPORT ON THE DEVELOPMENT OF
PROPOSED STANDARDS FOR UNITS WITH
CAPACITY GREATER THAN 250 TONS PER DAY

EPA PRESENTATION

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The Administrator signed air emission standards for municipal waste combustors (MWC's) on January 11, following a proposal of standards and emission guidelines under Section 111 of the Clean Air Act a little over a year ago. On November 15 of last year, Congress passed the Clean Air Act Amendments (CAAA) which contain specific provisions for additional requirements relative to municipal waste combustors. This presentation will briefly outline the rules which the Administrator signed in order to lay the foundation for the main focus of the presentation which is a discussion of the technical effort required for the development of rules for MWC's under the CAAA of 1990.

The presentation will begin with a discussion of the proposal and promulgation of the current new source performance standards (NSPS) and guidelines as background. Then I will describe the requirements of Title III Section 129 of the CAAA for MWC's. In particular, I will address our technical views on several of the new emissions limits which we will be establishing under Section 129, including limits for mercury, lead, cadmium, and NO_x from existing sources. Finally, I will provide a brief summary and schedule for the new standards.

The current new source performance standards and emission guidelines for existing sources were proposed on December 20, 1989, and the final standards were signed by the Administrator on January 11, 1991. In the intervening time period, the CAAA were enacted on November 15, 1990. The CAAA of 1990 contain

provisions under Section 129 of Title III which deal with various types of solid waste incinerators and, in particular, MWC's.

The NSPS applies to new MWC units larger than 250 tpd. A new unit is defined as a unit which commences construction after December 20, 1989. The guidelines apply to existing units with capacities greater than 250 tpd. However, there are different limits for MWC facilities smaller or larger than 1100 tpd due to the consideration of the economic impacts of applying the controls required for larger facilities to the smaller facilities.

The pollutants regulated are MWC emissions and nitrogen oxides (NO_x) for new units only. MWC emissions, as a class, cannot be measured so we subcategorized these into MWC metal emissions, MWC organic emissions, and MWC acid gas emissions, and established emission limits for these categories of pollutants which will effectively reduce MWC emissions.

The emission limits for the standards and guidelines under Section 111 are technology-based. The standard is best-demonstrated-technology (BDT) which is defined as the best system of continuous emission reduction which has been adequately demonstrated taking into account cost, energy, and environmental impacts. The best demonstrated technology for the recently signed rules includes two components: good combustion practices (GCP) for combustion control and post-combustion control of air emissions.

At the outset it should be noted that the materials separation requirements for MWC's which were a part of the proposal package, were not promulgated. The bases for this decision are fully discussed in the Federal Register publication of the promulgated rules. The decision was generally based on the conclusion that costs would be excessive for some communities.

The good combustion practices apply to both new and existing facilities and consist of four requirements regarding: load level, temperature at the inlet to the particulate matter (PM)

control device, carbon monoxide (CO) emissions, and operator certification and training. The load level must be maintained at less than 100% of the maximum demonstrated during compliance testing. Similarly, the temperature at the PM control device inlet must be maintained at no more than 30°F above the maximum demonstrated temperature. This is to minimize the post-combustion formation of dioxins and furans. CO emission limits are based on what is deemed to be the result of efficient combustion for various combustor types.

The final element of GCP is operator certification and training. All chief facility operators and shift supervisors must be certified by the American Society of Mechanical Engineers (ASME). Also, a site-specific training manual and training for other personnel must be developed at each facility. This is considered a major part of GCP and one that we see as necessary to insure its implementation.

The air pollution control technologies which we settled on as best-demonstrated-technology are designed to reduce the full range of MWC emissions. The most effective is the spray dryer/fabric filter (SD/FF) which is capable of reducing emissions of organics, acid gases, and metals from MWC's to very low levels. Only slightly less effective are the spray dryer/electrostatic precipitator (SD/ESP), and dry sorbent injection (DSI) into the furnace or duct followed by particulate collection.

Selective non-catalytic reduction is considered the best-demonstrated technology for the removal of NO_x from MWC flue gas. It is currently installed on four MWC's in the U.S. and involves the injection of a reducing agent, either ammonia or urea, into the upper furnace to reduce NO_x to N₂.

The NSPS and guidelines signed by the Administrator on January 11, 1991, include several emission limits for each subcategory of MWC emissions. For the reduction of MWC metals, an emission limit was established for PM because metals in MWC flue gas generally behave like particulate matter with the exception of mercury. MWC organics were regulated as dioxins and

furans (CDD/CDF). MWC acid gas reduction involved emission limits for sulfur dioxide (SO_2) and hydrogen chloride (HCl). There is a NO_x emission limit for new sources and opacity is limited to 10 percent for all units.

For existing MWC facilities less than 1100 tpd with units greater than 250 tpd, the emission limits were based on a BDT involving the retrofit of DSI onto an existing ESP. The PM is limited to 0.03 gr/dscf, CDD/CDF are limited to 125 ng/dscm (250 ng/dscm for RDF facilities), and HCl and SO_2 must be reduced by 50 percent.

For existing MWC facilities greater than 1100 tpd with units greater than 250 tpd, the emission limits were based on a BDT involving the retrofit of an SD onto an existing ESP. The corresponding PM emission limit is 0.015 gr/dscf, CDD/CDF are limited to 60 ng/dscm, and SO_2 and HCl must be reduced by 70 and 90 percent, respectively.

For all new facilities with units greater than 250 tpd, the BDT selected was SD/FF. The emission limit for PM is 0.015 gr/dscf. For CDD/CDF, the emission limit is 30 ng/dscm and SO_2 and HCl must be reduced by 80 and 95 percent, respectively. An NO_x emission limit of 180 ppmv was selected based on the application of SNCR.

This concludes my discussion of the standards and guidelines signed on January 11, 1991. The remainder of the presentation will focus on the technical work that lies ahead as a result of the 1990 CAAA, Title III, and how Section 129 will impact the current standards.

Title III, Section 129 of the 1990 CAAA requires EPA to review the regulations as well as promulgate any revisions and additional requirements for both new and existing MWC's under both Sections 111 and 129. We are required to promulgate rules for all MWC units greater than 250 tpd by November 15, 1991, and for units \leq 250 tpd by November 15, 1992. We are referring to the regulatory development for the large units as MWC II and for

the small units, MWC III. The remainder of my presentation will focus primarily on MWC II.

The requirements of Section 129 for new and existing MWC's involve both a review of the current standards to compare to the basis for standards under Section 129, as well as the addition of several requirements. We will be reviewing the numerical emission limits for PM, opacity, SO₂, HCl, NO_x from new MWC's, CO, and dioxins and furans. With regard to additional requirements, we must establish emission limits for Pb, Cd, and Hg from new and existing MWC's, and NO_x from existing MWC's.

Section 129 also requires us to develop siting requirements for new sources to minimize the potential for health and environmental impacts. Comprehensive monitoring requirements also are included.

In addition, the EPA is required to develop and promote a model State program for the training and certification of facility operators. This program must be prepared by November 15, 1992, and any plant operating 3 years later, without implementing the program, would be in violation of the law. Finally, Section 129 explicitly exempts from the standards units that combust 30% or less municipal solid waste by weight.

The emission limits which we establish for MWC's under Section 129 must be based on maximum achievable control technology (MACT). However, the limits we establish for new sources shall not be less stringent than that achieved by the best controlled similar source. For existing units, the limits shall not be less stringent than the average emission limitation achieved by the best performing 12% of the existing units.

The following slides will attempt to outline our thinking relative to MACT limits for the various pollutants for which we must set limits, both for new and existing sources.

Initially, for review of the NSPS, we must consider whether the SD/FF is MACT for MWC emissions, specifically acid gases, particulate, and dioxins and furans. It is the staff thinking at this point, that SD/FF appears to be MACT for MWC emissions. The

limits we promulgated, as I mentioned earlier, were based on the BDT standard of Section 111 which, in several respects, is similar to the MACT requirements in this case.

Similarly, the emission limits for new sources for NO_x were based on a BDT of SNCR which is used on four facilities in the country. Therefore, we would consider that a new MWC with SNCR for the control of NO_x would meet the MACT requirement as a best-controlled similar source.

As far as the review of the existing source guidelines is concerned, for the control of MWC emissions, I would ask you to recall the MACT requirements which require that we set limits no less stringent than the emissions from the best-controlled 12% of the sources. Currently, 25% of existing MWC units > 250 tpd use SD/FF for the control of these pollutants. This is a level of control which we did not require in the current guidelines, but one which we must consider based on a strict reading of Section 129.

To summarize, the review of the current standards in light of the MACT requirements will probably result in no revision to the NSPS. However, due to the number of existing facilities with SD/FF, there is the potential for revision of the existing source guidelines.

An addition which we must make only to the existing source guidelines is to establish a NO_x emission limit for existing units. Referring once again to the MACT definition, it is obvious that since SNCR for NO_x control is employed at only four facilities, much less than 12% of existing facilities have any NO_x control at all. Therefore, we will consider what control is appropriate considering costs and any non-air quality impacts.

Retrofitting SNCR is generally not difficult, either technically or in terms of costs. Based on our cost procedures, the difference in cost for installing SNCR on a new versus old unit is 10 to 15 percent. This relatively small cost impact will be given strong consideration in our decision whether or not to set a NO_x limit for existing MWC's.

The next addition to the regulations for both new and existing sources, which is required under Section 129, is an emission limit for mercury. Mercury emission limits were neither proposed nor are they in the current regulations. In the preamble to the proposal, we discussed the fact that we considered proposing a mercury emission limit but the data were contradictory. We elected instead to study the problem further.

At this point, we would conclude that there is no control technology for mercury in operation on MWC's in the U.S.

Control technologies for mercury exist on plants in both Europe and Canada. Two of these are additive injection technologies using sodium sulfide (Na_2S) and activated carbon. Another is wet scrubbing.

Sodium sulfide injection is applied at five facilities, four in Europe and one in Canada, with Flakt DSI/FF control. This control system includes a water-spray quench chamber followed downstream by an injection tower into which dry, hydrated lime is injected.

Sodium sulfide is a soluble, crystalline solid. Aqueous Na_2S is corrosive but this has not been a problem at the plants using it. It offgases hydrogen sulfide which can be vented or is injected into the combustor and burned. In general, the safety and handling characteristics of Na_2S are similar to those of lime.

For mercury control, Na_2S solution is injected upstream of the quench chamber through nozzles in the duct. Although the reactions involved are not known, in general, Na_2S reacts with the Hg and HgCl_2 in the flue gas precipitating HgS which is collected as particulate matter. The data we have from two of the facilities using Na_2S indicate the system is capable of reducing Hg by 75 to 95 percent. The total cost of the system, based on vendor quotes and discussions with the Canadian facility, is \$1 to \$3 per ton of waste burned.

Activated carbon use for Hg control on MWC flue gas is another duct injection technology which has been patented by

Niro. The activated carbon is injected upstream of the acid gas control device at rates of approximately 30 mg/Nm³. It has been applied on a full scale basis at a plant in Zurich, SW. This is a mass burn plant with SD/ESP control. The data from that plant indicate that 85 to 93 percent reduction of Hg is possible using activated carbon.

Activated carbon has also been tested on an MB facility in Amager, Denmark, equipped with an SD/FF with similar results. The significance of this is that activated carbon injection has been used on both SD/ESP and SD/FF equipped facilities.

Wet scrubbing, when applied to MWC's, involves techniques ranging from injection of a wet solvent into a spray or packed tower following an ESP. They are characterized by very low outlet temperatures resulting in the condensation of Hg. Wet scrubbing has generally not been applied in the U. S. However, the current regulations do not preclude the use of wet scrubbers as long as the required emission limits are met.

We have assembled data from Belco Technologies on their wet scrubbing systems which they refer to as the EDV system. In this system, lime is used for the neutralization of acid gas and outlet temperatures are 150°F. Belco has supplied data from three European facilities which indicate that control of Hg exceeds 90 percent with the EDV system. However, the control of organics may be less than for dry acid gas control systems.

Another addition to the regulations will be emission limits for lead and cadmium. It is the staff thinking that there is no additional technology needed. There is no specific technology for the control of lead and cadmium from MWC's. However, as I mentioned earlier, the metals are still controlled to levels exceeding 99 percent by the current control technologies in place. This is because they behave like conventional particulate matter. Reduced temperatures that are present with an acid gas control system and the level of particulate control we are requiring are effective in achieving these levels of control.

A summary of our data shows that, at the current levels of PM control, an SD/FF can reduce Pb to 200 $\mu\text{g/dscm}$ and Cd to 20 $\mu\text{g/dscm}$. Similarly, an SD/ESP can reduce Pb and Cd to 400 and 30 $\mu\text{g/dscm}$, respectively. A DSI/ESP can reduce Pb to 1000 $\mu\text{g/dscm}$ and Cd to 60 $\mu\text{g/dscm}$.

Under Section 129 of the CAAA, the EPA must establish siting requirements for new sources. The language requires that the siting requirements minimize, on a site-specific basis, to the maximum extent practicable, potential risks to human health or the environment. The EPA's views on this issue are just evolving and currently span a broad range. At one end of the spectrum are the exclusion lists which would prohibit siting an MWC near national forests, aquifers, etc. At the other end of the spectrum are technical requirements relative to multi-site analysis and multi-media effects similar to the requirements under the National Environmental Policy Act (NEPA). Ultimately, we may conclude that a combination of these requirements is appropriate.

To summarize briefly, our work for MWC II involves both a review and additions to the recently signed MWC rules. The main consideration for the review is whether the current emission limits reflect MACT for new sources by requiring an SD/FF and SNCR for NO_x control. It is the staff thinking at this point that MACT is equivalent to the BDT determination made under the current NSPS.

For existing sources, the fact that 25% of existing units have SD/FF will require us to give strong consideration to applying SD/FF to large existing units.

The EPA must consider adding emission limits for NO_x for existing sources if appropriate. Due to minimal cost impacts, this will potentially result in retrofit of SNCR onto existing sources.

With regard to Hg, add-on controls for Hg are being operated and performance data are available for facilities from Europe and

Canada. However, these controls have not been applied with all types of MWC control.

Lead and cadmium are controlled like particulate matter. The current required levels of particulate matter control result in Pb and Cd removals exceeding 99 percent. Therefore, we will establish limits consistent with this level of control.

The schedule for MWC II requires promulgation under Section 129 by November 15, 1991. We are scheduled to propose the standard on May 7, 1991.

DISCUSSION

Following the EPA presentation, Ms. Vivian McIntire of the Committee asked whether, with the addition of Na_2S and the formation of HgS product, EPA has examined the flyash characteristics to determine if it is a hazardous waste. Mr. Johnston responded that it is the opinion of the EPA that it is not hazardous, and though there will be more Hg in the ash, it is not of concern with regard to leaching.

Mr. William O'Sullivan of the Committee recommended that mercury separation be taken into consideration for MACT. He also asked whether thermal DeNO_x had an effect on Hg emissions. Mr. Johnston outlined the history of this theory which was conceived at the time of the proposal when data from two facilities showed no Hg capture by an SD/FF. Both of these facilities use thermal DeNO_x . Up to that time, it had been believed that an SD/FF was capable of 75 percent control of Hg. Thus, it was hypothesized that the ammonia injection was affecting Hg control by SD/FF. Over the next year and a half, however, it became apparent that Hg control is primarily related to the carbon in the flyash leaving the combustor. Mr. Johnston noted that there is a test program being planned for this spring at an MWC in Stanislaus County, CA, to examine these theories.

Mr. O'Sullivan asked whether EPA has examined the possibility that Hg may escape from the ash in the landfill.

Mr. Johnston reemphasized that Hg does not leach but there is some evidence that there is the potential that Hg may offgas from ash. There has been no documentation of this phenomenon but EPA is seeking more information on this issue. Mr. O'Sullivan advised once again that, due to this potential problem, EPA should look at Hg waste separation.

Mr. O'Sullivan asked, in light of the fact that SD/ESP's have proven capable in some instances of performing as well as SD/FF's, whether the SD/ESP is ruled out under the current standards. Mr. Johnston responded that the NSPS and guidelines are emission limits which may be met by any control device.

Mr. O'Sullivan asked for averaging times for each of the emission limits in the EPA presentation. They were provided by Mr. Johnston: 24-hour geometric average for SO₂ and HCl; 24-hour arithmetic average for NO_x; 6-minute average for opacity; and manual sampling for PM and CDD/CDF. Mr. O'Sullivan asked if there was a required sampling time for PM. Mr. Johnston said that it is 5 hours. Mr. Walt Stevenson of EPA noted that there is a volume specification in the regulation.

Mr. O'Sullivan asked how EPA will account for test variability in the face of limited data in the determination of best technology, and whether there is a minimum number of tests necessary to set an emission limit. Mr. Johnston responded that there is no minimum, but MWC's do not suffer for lack of data. Mr. O'Sullivan particularly noted Hg as a limited data set and Mr. Johnston agreed.

Mr. Fred Porter of EPA, adding to the discussion, noted that the reasons for rejection of the Hg separation requirement will be discussed in the FR publication of the MWC regulations. The household battery separation programs, in the EPA's opinion, create problems: elevated Hg levels in battery storage areas, potential for explosions, and potential for ingestion. The programs are also of limited effectiveness with a maximum reported capture efficiency of only 15 percent. Household batteries are not the only source of Hg in waste and it is

difficult to conclude that if you took out a particular item whether you would observe reductions in Hg air emissions.

Ms. McIntre asked for an explanation of the existing source guidelines. Mr. Johnston explained that, under Section 111(d), the States are required to develop standards for their existing MWC's based on the guidelines within 9 months of promulgation. The EPA has the authority to approve or disapprove their standards. If a State fails to meet the schedule or the EPA disapproves, the EPA must establish standards for the State's MWC's. Mr. Johnston noted that Section 129 affects this requirement as well.

Dr. Patrick Atkins of the Committee asked what percentage increase in the cost of waste disposal was required for Hg control. Mr. Johnston compared the \$1 to \$3 per ton of waste burned cost for Hg control to the \$12 to \$15 cost of the acid gas control required by the regulation. Dr. Atkins asked how this would affect the tipping fees. Mr. Johnston responded that the current nationwide average tipping fee is \$25/ton but, depending on the area of the country, it may be as high as \$100/ton. Mr. Porter noted that these tipping fees are not necessarily for MWC's, but for waste disposal at landfills. Mr. Porter said that a typical new combustor cost is \$50-60/ton and with acid gas control, would increase costs 10 to 15 percent. By way of comparison, Hg control is only \$1 to \$3 per ton of waste.

Dr. Atkins asked if source separation technology alone would be capable of meeting 75 percent Hg reduction. Mr. Johnston responded that due to the fact that sources of Hg in waste are not known it would be unlikely. Mr. Porter added that there may be many opinions on this issue, but if a vendor were asked to guarantee that the limit would be met through source separation by removal of items from the waste, he would probably not offer a guarantee due to the uncertainty regarding the sources of Hg in waste. Dr. Atkins asked whether if a vendor could do it, is there a mechanism in the standards to allow this. Mr. Porter said that this would be accommodated because the standard is an

emission limit. Dr. Atkins asked if you could get a permit to build such a system. Mr. James Weigold of EPA said there is an innovative technology provision in Section 111 which may allow it.

Dr. John Pinkerton of the Committee asked whether any consideration was given to factoring in the health and environmental effects of Hg and Pb (NAAQS), and whether additional control would be far beyond that needed to eliminate their health effects. Mr. Weigold responded that these standards will be similar to other Title III standards. There will be a technology-based approach and risk assessment will not be part of the initial standards for MWC's.

Dr. Pinkerton noted that the MWC risk assessments he has seen indicate Cd and CDD/CDF may be a cause for concern but not Pb and Hg. Mr. Porter said that EPA is not planning to do a risk assessment because this is a MACT standard. Mr. Porter observed that an earlier and very preliminary risk assessment had been done. Speaking to Hg, he said that the earlier risk assessment may not have adequately addressed the bioaccumulation effects of Hg and this remained a major critique of that risk assessment.

Dr. Pinkerton asked why EPA would need to consider siting requirements. Mr. Porter said that siting requirements are mandated by Section 129. The EPA has never done siting requirements as part of CAA emission standards and our approach is evolving at this point. Dr. Pinkerton asked if it was conceivable that the EPA may find the present state of permitting sufficient as siting requirements. Mr. Porter said that in his opinion, the Agency could, but cautioned that it would be unwise to assume this.

Mr. William Dennison of the Committee noted that the determination of best technology and siting are distinct. Because the receiving environment differs from site to site, so will the impacts and this may result in different determinations of best technology. Risk depends on the particular characteristics of the receiving environment in terms of

meteorology and potential residential exposure and therein lies the distinction.

Mr. Weigold asked the Committee if they knew of a situation where a site analysis was done to the satisfaction of the community in which the site was proposed. Mr. Dennison recalled one such situation and also recalled receiving a letter in support from the Sierra Club. Mr. Dennison subsequently corrected this comment. In fact, the project was sited before risk assessments were conducted. The project was not opposed. There was a letter in support of the project from the Sierra Club, but Mr. Dennison could not recall if that letter addressed any risk or acceptance of risk by that group.

Ms. McIntire asked whether the siting requirements applied to new or existing sources. Mr. Johnston responded that they applied to new sources only.

Mr. Dennison commented that general separation requirements should be put back in the standards. He also advised that NO_x control should be implemented in conjunction with effective PM removal due to the sublimation properties of one of the products. Good particulate control is a necessity and NO_x control is not something that can be done independently. He also observed that the ash handling characteristics he has seen are inadequate and upgrading needs to be done in terms of ash handling and fugitive emissions, and these requirements should be included in the standards. Mr. Dennison also suggested, in terms of operation, that startup/shutdown be considered.

Mr. O'Sullivan followed up on the issue of whether there are data to indicate that Hg separation was effective. It is his understanding that experience in Sweden resulted in 50 percent reduction. Also, a New Jersey facility not meeting its permitted Hg emission limit was required by the State to implement a Hg separation program. Subsequent tests indicated 80 percent removal.

Mr. David B. Sussman, representing Ogden Martin Systems, Inc., made a presentation to the Committee on the MWC standards

(Attachment A). Following his presentation, Mr. Weigold asked Mr. Sussman about his statement indicating no link between a PSD limit and the determination of a national limit considering that MACT for new sources requires the control be that of the best-controlled similar source. Mr. Sussman responded that MACT is technology-based not "numbers" per se. One must determine what is the best technology in terms of the numbers it achieves, but the emission limits must reflect MACT, not the lowest "numbers" that have ever been achieved by that technology. Using PM as an example, the 0.015 standard is above the measured "numbers." The 0.015 is a never-to exceed national standard which requires a vendor to design for much less. A PSD permit, however, may reflect the measured "numbers" and this is inappropriate particularly as it nears the effectiveness of the measurement method.

Mr. Weigold asked if this suggested that the PSD numbers were not achievable. Mr. Sussman said that some have questionable achievability on a long-term basis. However, the key difference between PSD numbers and a national standard is that PSD numbers are "negotiated" between the permittee and the regulating Agency, whereas a national standard developed under Section 111 or Section 129 of the Clean Air Act amendments must be based on "demonstrated" performance of emission control technology. If people find they are unable to achieve negotiated PSD numbers in actual practice, then they can appeal to the regulating Agency and apply for revisions to the numbers in additional negotiations. If people find they are unable to meet a national standard developed by EPA, they have no recourse - they cannot renegotiate it.

Dr. Pinkerton asked if Ogden-Martin agreed with the costs presented by EPA for mercury control. Mr. Sussman said that, considering the basis, he could not disagree, but the long-term cost of this new technology is uncertain. Dr. Pinkerton asked if the ash was hazardous from such a system. Mr. Sussman responded that HgS has a high vapor pressure and will not leach. The

increase in the concentration of Hg in the ash is small. With the use of activated carbon injection, there may be chemisorption so Hg will not sublime, evaporate or leach. Therefore, Mr. Sussman agreed that Hg control can be done in such a way as to not appreciably change ash characteristics and render it hazardous.

Mr. Sussman also commented that the wet scrubber data presented by EPA was from old European facilities and the Hg removal was probably a function of the carbonaceous material in the ash leaving the combustor and not condensation of Hg. If there were little carbon in the ash, one may have observed the same results as for SD/FF. Mr. Sussman also said that, although total CDD/CDF does not increase across the wet scrubber, the toxic equivalence (TEQ) does increase which is significant because the industry is regulated by TEQ in most States.

Dr. Pinkerton asked whether there should be a percent reduction or emission limit for Hg. Mr. Sussman responded that the European standard, which is $130 \mu\text{g}/\text{Nm}^3$ at 7% O_2 , is achievable, but 75 percent removal is also needed as an alternative limit due to the variability in Hg emissions.

Mr. O'Sullivan suggested that permit limits are hard and fast limits. As an example, a New Jersey facility needs to retrofit DeNO_x because they did not meet their NO_x emission permit limit. With regard to PM, he asked Mr. Sussman's opinion of a 0.010 standard. Mr. Sussman began his response by noting that there is a distinction between lowest achievable emission rate (LAER), BDT, and MACT. If costs are not considered, 0.010 is achievable, but 0.010 is LAER and is appropriate only in a non-attainment total suspended particulate (TSP) area and BDT and MACT determinations would not support it. Mr. Weigold noted that LAER is not considered in MACT.

Mr. David Beachler of Westinghouse made a presentation on behalf of the Institute of Resource Recovery (IRA) (Attachment B). Following the presentation, Dr. Pinkerton asked if \$1-3 per ton of waste burned is an appropriate cost for mercury control.

Mr. Beachler responded that it is difficult to say at this time. Dr. Pinkerton asked if mercury-containing ash is a hazardous waste. Mr. Beachler said no.

Dr. Pinkerton asked if IRR would sponsor testing to validate the Hg measurement method. Mr. Beachler indicated concern regarding the method validation but IRR has not moved forward in that respect. Mr. Porter responded that EPA believes the method yields valid and accurate results and Ogden-Martin and EPA have a program to continue with this type of evaluation. Mr. Beachler added that Westinghouse has done testing, which EPA reviewed on site and split samples with EPA, but the results are not yet available.

Ms. McIntire asked if the Canadian MWC facility using Na_2S injection to control Hg may differ from U. S. plants. Mr. Beachler said all sources will differ with respect to metals. European facilities will differ from U. S. facilities. Mr. Beachler, therefore, said it is difficult to take a limited data base and conclude it will work on all U. S. facilities.

Ms. McIntire asked how many test runs were conducted at the facility. Mr. Johnston responded that EPA has approximately 18 test runs including optimization runs, as well as runs on the outlet of all three units following optimization. Ms. McIntire asked if we had taken U. S. waste there to be burned. Mr. Johnston responded that EPA had not. However, in Vancouver the inlet levels of Hg were high as opposed to those of Europe which are typically about one-third of the levels seen at U. S. facilities. The inlets in Vancouver were 600-800 $\mu\text{g}/\text{dscm}$ while the U. S. average is 600 $\mu\text{g}/\text{dscm}$. Therefore, the Hg levels at Vancouver are similar to those of U. S. facilities. Ms. McIntire asked about the test period. Mr. Johnston responded that use of the Na_2S technology at Vancouver started in December 1989 with optimization work and extended to April of 1990 under various test conditions.

Mr. O'Sullivan commented that it is gratifying to see the way the industry proactively shares data. He asked Mr. Beachler

what the limit on Hg should be. Mr. Beachler said that IRR could not respond due to the lack of testing with Hg controls and could not guarantee any limit at this time. IRR will continue to look at this and provide EPA with information as it becomes available.

Dr. Atkins asked Mr. Beachler if he agreed that MACT was no control for existing sources for Hg. Mr. Beachler agreed. Mr. Porter clarified that the baseline for MACT is no control for Hg since less than 12 percent of existing facilities have installed Hg control. MACT, however, allows you to go beyond what is currently applied.

Mr. William Schott and Mr. Chris Pedersen of Kimre, Inc., presented information on wet scrubbers. (Attachment C) Following the presentation, Ms. McIntire asked how one can be assured vendor guarantees will be met. Mr. Pedersen responded that European guarantees are more strict and wet scrubbers are successfully used on MWC's in Europe. Ms. McIntire asked about testing methodology and frequency in Europe, but Mr. Pedersen could not speak to this.

Mr. O'Sullivan asked Mr. Pedersen if Kimre has supplied available test data to EPA. Mr. Pedersen claimed EPA was not interested in receiving it. Some of the test results were not Kimre property, but they are available from public sources. Kimre does not supply scrubber equipment.

Mr. Weigold responded that EPA is interested in the data. Mr. James Kilgroe of EPA reiterated this, and noted that he had been to Europe and had experience with MWC control from around the world and had looked at all types of controls. Mr. Pedersen responded that the premise of the standards are dry scrubbers and Western Europe has rejected this. Mr. Kilgroe refuted this.

Mr. Porter said wet scrubbers were considered in the regulations development and EPA continues to be interested in wet scrubbing and is willing to meet with anyone and discuss it. He also noted that the slides presented by Kimre on EPA regulations were extremely misleading and in a number of cases plainly incorrect. .

Mr. Dennison made the point that any control is acceptable as long as the emission limits are met. Mr. Pedersen agreed, but a company will not do more than is required.

Mr. Porter did not want to leave the impression that wet scrubbers are superior to dry scrubbers. EPA has not seen a significant difference between the performance of wet and dry scrubbers particularly with regard to dioxins and furans control, but this issue will be revisited over the coming months.

Mr. Kilgroe pointed out that no wet scrubbers are operating in the U. S., but that the wet scrubber may not meet the Swedish dioxin standard and, therefore, dry scrubbing may be superior. Mr. Stevenson also indicated that the EPA standard for CDD/CDF is not based on TEQ and that the EPA standard is very similar to the Swedish standard in that respect. Lower levels are achievable in practice.

Mr. Richard Anderson of Wheelabrator Technologies presented data on metals control from MWC's (Attachment D) Following the presentation, Mr. David White of Radian asked if each data point was a separate run. Mr. Anderson responded that it was.

Dr. Atkins asked if the conclusion that PM was not a surrogate for Cd and Pb was valid. Mr. Anderson said that with data from a SD/ESP, a linear relationship exists, but they cannot confirm or deny it for SD/FF.

Mr. Dennison asked that if the flue gas temperature were taken into account would this be resolved. Mr. Anderson responded that the condensation occurs before the scrubber for the less volatile metals. Temperature is not important after the scrubber. Therefore, temperature is not important for Pb and Cd, but is for Hg.

Dr. Jim Crowder of EPA asked if the analysis would change if done using the average of three runs as in a compliance test. Mr. Anderson responded that whether one uses all the test runs or averages, the resulting overall average is essentially the same. Mr. Anderson emphasized that the scatter in the data must be

considered in establishing an emission limit for metals, particularly since the PM standard may be tightened under Section 129.

STATUS OF REGULATIONS DEVELOPMENT

FOR

MUNICIPAL WASTE COMBUSTORS

JANUARY 31, 1991

INTRODUCTION

- **BACKGROUND**
 - **PROPOSAL/PROMULGATION OF NSPS AND GUIDELINES**
- **TITLE III, SECTION 129 OF CAA AMENDMENTS**
 - **MERCURY**
 - **PB/CD**
 - **NO_x (EXISTING MWC'S)**
- **SUMMARY**
 - **SCHEDULE**

BACKGROUND

- **NEW SOURCE PERFORMANCE STANDARDS/EXISTING
SOURCE EMISSION GUIDELINES**
 - **PROPOSAL** **12/20/89**
 - **SIGNED BY ADMINISTRATOR** **1/11/91**
- **CLEAN AIR ACT AMENDMENTS
OF 1990** **11/15/90**
 - **TITLE III, SECTION 129**

NSPS/GUIDELINES

- **APPLICABILITY**

- **NSPS**

- NEW MWC UNITS > 250 TPD**

- COMMENCE CONSTRUCTION AFTER
DECEMBER 20, 1989**

- **GUIDELINES**

- EXISTING MWC UNITS
> 250 TPD**

- DIFFERENT LIMITS FOR MWC
FACILITIES SMALLER/LARGER THAN
1100 TPD**

- **POLLUTANTS**

- **MWC EMISSIONS (MWC METALS, MWC
ORGANICS, MWC ACID GASES)**

- **NITROGEN OXIDES**

- **BASIS FOR STANDARDS AND GUIDELINES IS BDT**

- **GOOD COMBUSTION PRACTICES**

- **POST COMBUSTION CONTROLS**

- **MATERIALS SEPARATION**

GOOD COMBUSTION PRACTICES

POLLUTANT OR PARAMETER	LIMIT
Maximum load level	< 110% of demonstrated
Maximum temperature at PM control device inlet	< 30°F above maximum demonstrated
<u>CO Emissions (ppmv):</u>	
Modular	<u>New</u> <u>Existing</u>
Mass burn waterwall	50 50
Mass burn refractory	100 100
FBC	100 100
MB rotary waterwall	100 250
RDF spreader stoker	150 200
Co-fired	150 150

OPERATOR TRAINING AND CERTIFICATION

TWO CLASSES OF OPERATORS MUST BE CERTIFIED BY ASME

POST COMBUSTION CONTROL

MWC EMISSIONS

- **SPRAY DRYER/FABRIC FILTER (SD/FF)**
- **SPRAY DRYER/ELECTROSTATIC PRECIPITATOR (SD/ESP)**
- **DRY SORBENT INJECTION/ELECTROSTATIC PRECIPITATOR (DSI/ESP)**

NO_x

- **SELECTIVE NON-CATALYTIC REDUCTION**

**STANDARDS AND GUIDELINES
POST COMBUSTION CONTROL**

POLLUTANT	EXISTING FACILITIES		NEW FACILITIES
	< 1100TPD	> 1100 TPD	
MWC Metals, gr/dscf (as PM)	0.03	0.015	0.015
MWC Organics, ng/Nm³ (as CDD/CDF)	125 (250 RDF)	60	30
MWC Acid Gases			
HCl, % Red./ppmv	50/25	90/25	95/25
SO₂, % Red./ppmv	50/30	70/30	80/30
NO_x, ppmv	--	--	180
Opacity	< 10%	< 10%	< 10%

TITLE III, SECTION 129 OF CAAA

- **REQUIRES REVIEW OF REGULATIONS AND
PROMULGATION OF ADDITIONAL AND REVISED
REQUIREMENTS FOR NEW AND EXISTING MWC'S**
 - **SECTIONS 111 AND 129**
- **SCHEDULES**
 - **MWC UNITS $>$ 250 TPD
NOVEMBER 15, 1991 - MWC II**
 - **MWC UNITS \leq 250 TPD
NOVEMBER 15, 1992 - MWC III**

SECTION 129 REQUIREMENTS FOR STANDARDS AND GUIDELINES

- **REVIEW OF NUMERICAL EMISSION LIMITS FOR:**
 - **PARTICULATE MATTER (FINE)**
 - **OPACITY**
 - **SULFUR DIOXIDE**
 - **HYDROGEN CHLORIDE**
 - **NO_x (NEW)**
 - **CO**
 - **CDD/CDF**
- **ADD NUMERICAL EMISSION LIMITS FOR:**
 - **PB, CD, HG**
 - **NO_x (EXISTING)**
- **SITING REQUIREMENTS**
- **MONITORING REQUIREMENTS**
- **DEVELOP AND PROMOTE A MODEL STATE PROGRAM
FOR TRAINING AND CERTIFICATION**
- **DO NOT APPLY TO UNITS THAT COMBUST 30% OR
LESS MSW BY WEIGHT**

BASIS FOR EMISSION LIMITS

- **MAXIMUM ACHIEVABLE CONTROL TECHNOLOGY (MACT)**
 - **NEW UNITS - SHALL NOT BE LESS STRINGENT THAN THAT ACHIEVED BY BEST CONTROLLED SIMILAR SOURCE**
 - **EXISTING UNITS - SHALL NOT BE LESS STRINGENT THAN THE AVERAGE EMISSION LIMITATION ACHIEVED BY THE BEST PERFORMING 12% OF THE EXISTING SOURCES**

REVIEW OF NEW SOURCE STANDARDS

MWC EMISSIONS

- **SD/FF APPEARS TO BE MACT**
 - **ACID GASES (SO₂ AND HCL)**
 - **PARTICULATE MATTER**
 - **CDD/CDF**

NOX

- **IS MACT SNCR FOR NO_x?**
 - **SNCR APPLIED TO FOUR MWC'S**

REVIEW OF EXISTING SOURCE GUIDELINES

- **MWC EMISSIONS**
 - **ACID GASES (SO₂ AND HCL)**
 - **PARTICULATE MATTER**
 - **CDD/CDF**
- **EXISTING CONTROL**
 - **25% OF EXISTING UNITS HAVE SD/FF**

REVIEW OF NEW/EXISTING SOURCE STANDARDS/GUIDELINES

- **SUMMARY**
 - **NO REVISIONS TO NSPS**
 - **POTENTIAL FOR REVISION TO EXISTING SOURCE
GUIDELINES**

ADDITIONS TO EXISTING SOURCE GUIDELINES

NO_x

- **MACT IS "NO CONTROL"**
- **RETROFIT TO UNITS > 250 TPD IS 10 TO
15 PERCENT COST INCREASE**

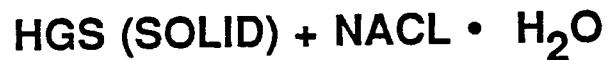
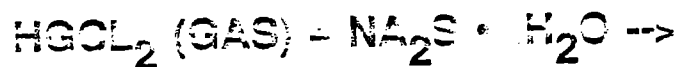
ADDITIONS TO NEW/EXISTING SOURCE STANDARDS/GUIDELINES

MERCURY

- **NO MERCURY EMISSION LIMITS PROMULGATED**
- **MACT IS NO CONTROL (U.S.)**
- **CONTROL TECHNOLOGIES - EUROPEAN/CANADIAN**
 - **SODIUM SULFIDE INJECTION**
 - **ACTIVATED CARBON INJECTION**
 - **WET SCRUBBING**

NA₂S INJECTION

- APPLIED AT FIVE FACILITIES WITH FLAKT DSI/FF CONTROL
- NA₂S PROPERTIES
 - SOLUBLE CRYSTALLINE SOLID
 - CORROSIVE
 - OFFGASES H₂S
- CHEMISTRY



- 75 TO 95% REDUCTION (25 TO 160 µg/DSCM)
- TOTAL COST: \$1 - 3 PER TON OF WASTE

ACTIVATED CARBON

- **DUCT INJECTION**
- **FEEDRATE: 30 MG/NM³**
- **ZURICH, SW (MB/SD/ESP) - 85 TO 93% REDUCTION
(20 TO 50 µG/DSCM)**
- **AMAGER, DENMARK (MB/SD/FF) - 30 TO 85%
REDUCTION (<100 µG/DSCM)**

ESP/WET SCRUBBING

- **INJECTION OF WET SOLVENT INTO SPRAY/PACKED TOWER FOLLOWING ESP**
- **GENERALLY NOT APPLIED IN U.S.**
- **BELCO TECHNOLOGIES - EDV SYSTEMS**
 - **LIME USED FOR NEUTRALIZATION OF ACID GAS**
 - **OUTLET TEMPERATURE - 150°F**
 - **DATA FROM THREE EUROPEAN FACILITIES**
- **EXCEEDS 90% CONTROL (20 TO 60 μ G/DSCM)**
- **CONTROL OF ORGANICS MAY BE LESS THAN FOR DRY ACID GAS CONTROL SYSTEMS**

ADDITIONS TO NEW/EXISTING SOURCE STANDARDS/GUIDELINES

LEAD AND CADMIUM

- **NO SPECIFIC CONTROL**
- **BEHAVES LIKE CONVENTIONAL PARTICULATE
MATTER**
 - **REDUCED TEMPERATURE**
 - **EFFICIENT PARTICULATE COLLECTION**

PIB/CD CONCLUSIONS

CONTROL	PB (μ G/DSCM)	CD (μ G/DSCM)
SD/FF	200	20
SD/ESP	400	30
DSI/ESP	1000	60

SITING REQUIREMENTS

- **EXCLUSION LISTS**
 - **PROHIBIT SITING AT WETLANDS, NATIONAL FORESTS, ETC.**
- **NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)**
 - **TECHNICAL REQUIREMENTS RELATIVE TO MULTI-SITE ANALYSIS AND MULTI-MEDIA EFFECTS**
- **OTHER**

SUMMARY - MWC II

REVIEW

- **MACT IS EQUIVALENT TO BDT FOR NEW SOURCES**
- **MACT FOR EXISTING SOURCES MAY BE SD/FF**

ADDITIONS

- **NO_x CONTROL FOR EXISTING SOURCES RESULTS IN MINIMAL ADDITIONAL COSTS**
- **ADD-ON CONTROLS FOR MWC MERCURY EMISSIONS ARE BEING OPERATED**
 - **PERFORMANCE DATA AVAILABLE FOR CANADIAN/EUROPEAN FACILITIES**
 - **HAS NOT BEEN APPLIED TO ALL TYPES OF CONTROLS**
- **PB AND CD CONTROLLED LIKE PARTICULATE MATTER**

SCHEDULE - MWC II

PROPOSAL

5/7/91

PROMULGATION

11/15/91

TESTIMONY BEFORE THE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

Research Triangle Park, North Carolina

January 31, 1991

By

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MUNICIPAL WASTE COMBUSTOR STANDARDS

Ogden Martin Systems (OMS) wishes to thank the Office of Air Quality Planning and Standards of the United States Environmental Protection Agency for the opportunity to present information pertinent to the requirements of Section 129 of the Clean Air Act Amendments (CAAA) of 1990.

By way of background, municipal waste combustion (MWC) is a waste treatment technique which reduces the volume of municipal solid waste requiring ultimate disposal by about 90% and recovers the intrinsic energy in the waste, usually as exportable electric power at the rate of about 550 kwh per ton of trash. The technique is a valuable tool for solid waste managers to use in dealing with America's ever increasing problem of what to do with the trash thrown away by 250 million people. Proper regulation of this option (and also the other waste management options) is important

in order to protect the public health and environment, and to instill confidence in the general public that waste management activities are not a menace. There is, however, a point where the complexity of regulations far exceed what is necessary to protect public health, and where no real environmental benefits are realized from the additional costs imposed. The requirements on today's agenda pertaining to lead and cadmium are examples of complexities from which no real benefits will ensue.

The New Source Performance Standards and Emissions Guidelines (NSPS/EG) promulgated earlier this month have addressed the emissions from new and existing MWC facilities in an adequate way. In fact, the NSPS/EG are the most stringent and complex regulations that EPA has ever developed under Section 111 of the Clean Air Act. In addition, the Agency has never before seen fit to require retrofits of this magnitude on existing facilities.

The remarks that follow focus on mass burn units of greater than 250 TPD capacity.

MACT

For new units, the "Best Demonstrated Technology (BDT) standards as defined in Section 111 of the CAA promulgated earlier this month reflect "Maximum Achievable Control Technology (MACT) as defined by Section 129 of the CAAA. There are approximately 87 MWC mass burn units with capacities of >250 TPD located in, I believe, 36

facilities with capacities of >500 TPD. Of these, approximately 50 use spray dryer absorbers and fabric filters or ESP's as air pollution control devices. The best of these achieve emissions limitations equal to those promulgated as BDT in the NSPS. Consequently, no changes to the promulgated NSPS should be required to comply with the CAAA MACT.

For the emissions guidelines, EPA must make a very careful analysis as to whether the promulgated BDT requirement is as stringent as the MACT mandate. I believe there are about 32 units with capacities of greater than 250 TPD located in facilities with aggregate capacities of between 250 TPD and 1000 TPD. More than 10 of these have spray dryer absorbers/fabric filters. While the acid gas emissions achieved by these plants are lower than the limits promulgated in the EG, the SDA/FF-ESP control was part of the initial construction and not retrofited. The cost of adding SDA technology to the existing "large" plants was not deemed "cost effective" under BDT. The MACT mandate requires the same "cost of achieving such emission reduction" analysis and states "standards for existing units...may be less stringent than...for new...". Consequently, OMS believes the BDT standards for "large" facilities does in fact reflect MACT and no modifications to the promulgated EG is necessary.

There are also about 55 units as above in >1000 TPD plants; more than 20 use SDA/FF. In the case of "very large" existing

facilities, BDT and MACT are the same. OMS continues to believe the addition of an SDA to any existing facility or unit (no matter what size) is not cost effective within the meaning of Section 111 or 129 of the Act. This opinion, however, is obviously not shared by the EPA.

OMS is very willing to work with OAQPS in determining just what constitutes "...the average emissions limitation achieved by the best performing 12 percent of units in the category..."

NUMERIC EMISSIONS STANDARDS - METALS

Attached to this testimony are metals emissions data from OMS facilities that have been sampled for mercury, lead, and cadmium. The metal data is reported as ug/Nm³ corrected to 12% CO₂. As additional data becomes available, it will be forwarded to OAQPS. In addition, a spreadsheet containing the raw numbers has been sent to OAQPS on computer disk under separate cover for use in establishing proper numeric emission limits for metals. A computer disk updated with additional data was given to OAQPS today.

Two notes of caution when establishing a numeric emission limit for a metal: first, the data base is very soft. Metal emissions are almost 100% fuel related and represent a snapshot of what has been transpiring over a large period of time. Using a few one to two hour tests per year to quantify with great precision the emission resulting from about 8000 hours of running time on a MWC unit is

dangerous. When establishing an emission limit based on such a small data base, a limit with a percent reduction (as with SO₂) is strongly indicated. The health risk associated with measured metal emission rates are far below a creditable concern level, and prior to the passage of the CAAA, the Agency believed a limit on a surrogate for metals was sufficient to insure protection. Consequently, make sure the surrogate (still regulated as PM) and the numeric emission limit represent the same level of protection. There is further discussion on this topic under lead and cadmium.

The second note is regarding the testing methods. The data base was not generated using consistent methodology. Consequently the bias of individual numbers are unknown and the accuracy of the data base is in question. This is not to say that the data is no good, but rather to point out that the need for a careful determination of an emission number with a percent reduction for a metal when the control is BDT for PM.

The CAAA does include a provision on testing. It requires EPA to develop monitoring rules which contain "...provisions regarding the frequency of monitoring, test methods and procedures validated on solid waste incineration units (emphasis added), and the form and frequency of reports..." Once this provision is implemented by the EPA, the issue of method bias and data base validity will be moot. What is the status of the method validation program? Additional comments on testing methods are contained in the OMS comments on

mercury (attached).

MERCURY

Most of the comments OMS has concerning a mercury emission limit and the need for add-on mercury control is contained in the attached letter to the mercury docket (Attachment 1). In addition, our concerns have been discussed on the record at three or four Agency sponsored mercury meetings in 1990. Nothing has changed technically to alleviate these concerns; however, we do understand that the CAAA mandate will result in a mercury emission limit based on MACT and that the Agency now considers sorbent addition techniques demonstrated, available, and cost effective. While numerous health risk assessments and agency decisions have established that the uncontrolled emissions of mercury from MWC's do not present a health problem, the reduction of these emissions using additional control techniques is not without merit.

OMS believes it has the capability to achieve (on new SDA/FF equipped facilities) the European standard of 130 ug/Nm³ corrected to 7% O₂ or a 75% reduction, whichever is least stringent. We will continue to cooperate with EPA on mercury emissions by sharing data and making our facilities available for Agency research on method validation, control efficiencies, and interference issues.

LEAD AND CADMIUM

Establishing a numeric emission limit for a metal and a limit on

a surrogate in the same standard is a first for EPA. No other NSPS has quite a "belt and suspender" requirement. The most important thing EPA must accomplish in its deliberation over the "proper" limit is maintaining consistency between the numeric metal limit and the limit on the surrogate. As the limit on the surrogate (PM) is based on BDT/MACT, and the best technology for new units is SDA/FF or high efficiency ESP, and those devices can control to a limit of 0.015 gr/dscf correct to 7% O₂ for total PM (representing a percent reduction of total PM in the high 90% range), then it follows that a specific metal emission limit must be established following the same logic. In other words, the numeric metal emission limit must be at the level associated with the PM limit of 0.015 gr/dscf for new units. OMS believes that the extremely low PM emission routinely measured at its SDA/FF facilities and the ratio of metals at measured PM emissions are linear to the 0.015 PM limit and can be correlated to the 0.015 limit without regard to particle size. Above 0.015 or for units using SDA/ESP the linearity may not hold true.

Attachment 2 has the measured metal emissions from OMS SDA/FF equipped facilities with the associated measured PM emission. Attachment 3 has the same data for OMS ESP equipped plants. Note that Alexandria uses dry sorbent injection in-furnace and Haverhill has a spray dryer absorber. As one can see from the data, the cadmium and lead emissions are variable but dependent on the level of PM measured during the test. The data base provided

(Attachments 2 & 3) reflects the use of SDA/FF and ESP technology on OMS facilities tested between 1986 and 1990. The mean level of particulate control achieved by the SDA/FF facilities was 0.004 gr/dscf corrected to 12% CO₂, significantly below the BDT/MACT standard of 0.015 gr/dscf. The mean PM level for the ESP equipped facilities is 0.01 gr/dscf, below the BDT standard of 0.015 for "very large" existing MWC's and significantly below the 0.03 standard for "large" existing MWC's.

The combination of inherent variability in metals emissions coupled with the fact that metals emissions are associated with the PM control level achieved, requires the data to be normalized such that it reflects the application of the technology based standard, (i.e., SDA/FF) and not the variability of the data base itself. Therefore, reported metal concentrations have been normalized (Attachment 4) to account for PM loading reported from the SDA/FF units, such that the predicted metal emission is consistent with the BDT/MACT PM emission of 0.015 gr/dscf corrected to 12% CO₂. Attachment 5 has the data from ESP equipped units normalized in the same fashion. The adjusted metal emission factors, as collected from several OMS facilities, have been plotted as a probabilistic histogram with a both 90% and 95% confidence interval and percentile emissions calculated.

Two additional points with regard to lead and cadmium emissions need to be highlighted. First, the draft "Summary of Information

Related to Cadmium and Lead Emissions..." states that "...recently built SD/FF systems with tested PM emission rates of roughly 0.010 gr/dscf, cadmium emissions are generally less than 10 ug/dscm and lead emissions are less than 100 ug/dscm." Mean measured emissions of 10 ugm cadmium and 100 ugm lead are consistent with OMS data, but the mean of the PM emissions were much lower. Attachments 4 and 5 include OMS lead and cadmium normalized to a PM limit of 0.01 for informational purposes.

The second point for the record is that many MWC permits include limits on metals that have been accepted by facility operators that are not normalized to the PM limit. In fact, many permits have limits on all metals from arsenic to zinc "regulated by the Act." A condition in a PSD permit reflecting a non-normalized metal emission limit may seem inconsistent with the logic expressed above: it is not. An NSPS limit is a federally enforceable, national, never to exceed standard that we as systems operators must guarantee continuous compliance. A PSD permit condition for a single facility is quite different. It reflects the negotiation associated with New Source Review and is not necessarily a hard and fast limit. The enforcement of an exceedence of an NSPS limit - vs- a permit condition can result in entirely different compliance actions, with different responsible parties. Consequently, limits contained in permit conditions should not play any role in establishing a national NSPS limit.

The standard that EPA established for lead and cadmium on new units must be based on what the levels would be if PM is at the BDT/MACT point of 0.015. Likewise, the limits for existing units must reflect the PM loading.

In addition, as discussed in the general section on metals, the standard must contain a percent removal requirement.

5 Attachments

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AN OGDEN COMPANY

October 19, 1990

AIR DOCKET (LE-131)
ATTENTION DOCKET NO. A-89-08, CATEGORY IV-M
ROOM M1500
U.S. EPA
WASHINGTON, D.C. 20460

Ogden Martin Systems, Inc. (OMS) wishes to submit the following comments to the Docket concerning mercury (Hg) emission from Municipal Waste Combustors (MWC) and control thereof. OMS has reservations about the efficacy of developing a numeric and/or percent reduction Hg standard at this time. Based on the data contained in the Docket and presented at the public meeting, the standard would be based only on limited European and Canadian information, collected by using test methods that are both unverified and not applicable to U.S. facilities as EPA uses a different sampling approach. Our specific comments follow:

Data to Support Standard

The docket and EA notice indicates that EPA will be establishing an emission limit for Hg for both new and existing MWC's. The supporting data for this decision appears to be from a handful of facilities using at least three different control technologies. None of these facilities are located in the United States. There was no analysis on economic and energy trade-off's which is generally done pursuant to Section 111. The methods used in producing the data varied from test to test, and none were exactly the same as U.S. EPA sampling procedure. If the Hg emission limit is based on these technologies and European "standards", this commentor questions whether the Section 111 tests for "best demonstrated...continuous emission reductions..." have been met.

Existing Units

EPA indicates it will require an Hg emission limit for existing units that may be the same as for new. The "Emissions Guideline" (EG) proposed retrofit of existing units with duct or furnace injection of dry sorbent for acid gas control, good particulate control, and "good combustion practices" for control of organics. Yet all of the Hg sorbent techniques listed in the Docket were from units with either Spray Dryer Absorbers (SDA) or one wet system on several older MWC's (which may have high carbon carry-over from poor combustion). There is no data to indicate existing units will be able to meet the same Hg emission limit as new units without the same emission control train; i.e. SDA, fabric filter/ESP. There is no data to support any Hg emission limit on existing facilities complying with the EG retrofits. The requirement for SDA retrofit on existing units was deemed inappropriate in the "EG". Does EPA now plan to require SDA on existing units? If so, do they plan to examine the major cost implications of this action?

In addition to the general issues raised above, specific questions such as these must be answered prior to requiring an emission limit and a control technology for existing plants:

- o In order for sorbent control technologies (carbon, Na_2S) to be effective, is a temperature drop necessary between the point of sorbent injection and PM control?
- o Can ESP's efficiently collect the sub-micron particles of HgS resulting from Na_2S injection?
- o Can ESP's efficiently collect the fine low resistivity particles from carbon injection?
- o Will unreacted Na_2S corrode ESP's to the point where they are no longer usable?
- o Will injection of carbon produce a fire hazard in FF's operating without flue gas cooling?
- o With regard to wet systems, is the Hg reduction based on high carbon (from poor combustors) fly ash adsorbing Hg, or a condensation mechanism? Will wet systems remove Hg from MWC's that have "good combustion practices" and low carbon fly ash?

Emissions Trade-Off's

The Docket references test data which indicates the inverse relationship between dioxin/furan emissions and Hg emissions. Good combustion and associated low dioxin emissions leave little carbon on fly ash to adsorb Hg. On the other hand, carbonaceous

fly ash from MWC's operating at low combustion efficiencies, appear to readily adsorb Hg--the reason carbon injection works as a control method. Dioxin is a no threshold carcinogen whereas Hg is a systemic toxicant which has a threshold below which no health effect is observed. A number of Health Risk Assessments on MWC's have been produced (some reviewed by EPA Regional Offices) which show the presently "uncontrolled" levels of Hg emitted are well below the no effect level. Some of these HRA's have examined all pathways; i.e. inhalation, food chain, etc. While removal of as much Hg from the environment as possible is a proper goal, it should not be at the expense of dioxin emissions.

Mercury in Products

The variability of emissions data from <20 to >2000 ugms/Nm³ (assuming the test methods are reasonably accurate) indicates Hg content in MSW is very variable. When emissions for a single substance are fairly constant, experience indicates a ubiquitous distribution of constituent in the MSW. With Hg, the indication is that the emissions result from only a few specific Hg containing items i.e. batteries, florescent lights, certain electrical items. Based on this, it would be a better control strategy to require removal of Hg from these products or removal of the products from the waste stream. As the uncontrolled levels are well below the health effect threshold, would it not be feasible to require removal of Hg bearing products from the waste stream now, measure the reduction in emissions over a two year period, and then assess the need for an emission limit based on add on control technology?

Validation of Test Method

In addition to the issue of comparability of test data between Canada, Europe, and the United States, there may be a serious problem with the accuracy (bias) with both the EPA multi-metals and method 101-A Hg sampling trains. The possible chlorine interference issue is being addressed by other commentor's and will not be discussed here. EPA indicates a "precision" of between ± 5 to 11% (Docket item #7) for the method 101-A but no "bias" is noted. It should be noted that this validation was not on MWC flue gas. EPA also points out that they will continue to evaluate the method. With such uncertainty over the absolute accuracy of both the database and method, it would seem prudent to validate the method on MWC's, and correct the errors in the database (if they exist) prior to mandating an emission limit.

Enforcement

There are many references in the Docket to "European" standards. The approach to standards, permit conditions, and enforcement in Europe are quite different than in the U.S. A standard in Europe is more like guidance in the U.S., and there is a more "let's

work together" attitude between the regulators and regulated community than there is here. Our adversarial approach to permit issuance and enforcement, the questionable achievability of the Hg standard, and the probable bias in the test method may result in exceedences that are not "real". How does EPA plan to deal with this issue?

Vendor Guarantees

OMS is concerned that EPA is placing too much credence on data supplied by vendors of Hg control technologies (see OMS comments on the proposed NSPS/EG). The vendors continue to tout the technical ability of their machines but are unwilling to guarantee long-term performance. This leaves the system owners/operators and eventually the citizens of the municipalities served to bear the liability of compliance with a prematurely established Hg standard. Once a track record of an APCD is established and the long-term performance is understood, that liability can be qualified and consequently accepted.

Additional Data

OMS has sampled Hg emissions from a number of its facilities. Some tests were referenced in the docket, but additional data are available. The mean and distribution of the data from over 100 individual OMS tests are quite similar to that referenced in the Docket. The OMS emission numbers and supporting stack test reports can be provided if EPA so wishes.

We hope to continue working with EPA on this important rulemaking.

Sincerely,


David B. Sussman

Cadmium, Lead & Mercury Data from Scrubber/Baghouse

21-Jan-91

FACILITY	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3 @12% CO2	ug/Nm3 @12% CO2	ug/Nm3 @12% CO2	gr/dscf @12% CO2
BABYLON				0.0016
				0.0022
				0.0012
	0.950	0.850	570.000	0.0013
	0.650	2.600	650.000	0.0008
	0.650	1.100	200.000	0.0016
	5.770	47.309	444.835	0.0025
	5.243	44.039	199.423	0.0019
	5.372	23.614	394.149	0.0056
BRISTOL		60.000	210.000	0.0113
		20.000	70.000	0.0053
		10.000	40.000	0.0031
				0.0021
				0.0021
				0.0056
	2.773	18.040	67.699	0.0019
	0.321	8.758	61.043	0.0014
	1.203	22.910	207.827	0.0010
	0.950	79.465	29.868	0.0032
	1.907	2.791	135.818	0.0034
	4.471	21.244	41.380	0.0028
	1.590	35.531	13.959	0.0014
	2.965	7.435	1,115.277	0.0010
	2.726	14.069	154.763	0.0019
FAIRFAX	6.714	26.737	287.727	0.0026
	5.757	24.626	485.001	0.0014
	6.885	29.537	533.601	0.0020
	8.370	30.295	425.630	0.0099
	11.087	30.551	520.025	0.0110
	9.548	32.073	552.981	0.0090
		37.217	437.646	0.0021
	6.015	37.044	350.047	0.0017
	3.818	38.880	279.167	0.0024
	6.250	26.749	369.170	0.0042
	6.320	27.028	333.480	0.0045
	6.822	29.238	950.250	0.0047
HUNTSVILLE		58.720	536.068	0.0097
		61.016	594.408	0.0082
		52.411	2,974.667	0.0071
		13.060	589.841	0.0022
		12.399	363.478	0.0018
		9.928	437.749	0.0011
MARION				
		199.013	237.331	0.0211

Cadmium, Lead & Mercury Data from Scrubber/Baghouse

21-Jan-91

FACILITY	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3 @12% CO2	ug/Nm3 @12% CO2	ug/Nm3 @12% CO2	gr/dscf @12% CO2
		18.673		0.0129
		39.964		0.0136
				0.0035
			321.806	0.0029
			198.594	0.0055
		10.751		0.0030
		3.528		0.0101
		11.906		0.0044
				0.0044
				0.0020
		11.114		0.0035
		10.190		0.0035
		11.240		0.0090
				0.0008
				0.0004
				0.0009
				0.0014
				0.0020
				0.0010
				0.0013
				0.0016
				0.0100
				0.0080
				0.0060
				0.0070
				0.0070
				0.0050
INDIANAPOLIS				0.0021
				0.0034
				0.0039
			502.802	0.0026
			77.480	0.0031
			62.746	0.0024
		47.065		0.0019
		115.814		0.0024
		67.885		0.0022
		4.446	373.432	0.0064
		4.302	217.819	0.0021
		4.640	301.219	0.0036
				0.0038
				0.0050
				0.0034

Cadmium, Lead & Mercury Data from Scrubber/Baghouse

21-Jan-91

	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3	ug/Nm3	ug/Nm3	gr/dscf
FACILITY	@12% CO2	@12% CO2	@12% CO2	@12% CO2
				0.0031
				0.0011
				0.0035
STANISLAUS	3.800	42.500	379.000	0.0045
	1.470	9.400	766.000	0.0034
	0.250	21.000	490.000	0.0086
	2.280	47.400	431.000	0.0027
	2.800	40.800	501.000	0.0011
	1.970	34.700	615.000	0.0028
	1.9	28.0	548.000	0.0042
	1.3	29.8	412.000	0.0036
	1.8	25.3	414.000	0.0046
				0.0041
				0.0110
				0.0033
			692.000	
			757.000	
			811.000	
			585.000	
			633.000	
			466.000	
			494.000	
			591.000	
			728.000	
			557.000	
			777.000	
			533.000	
			1513.000	
			1729.000	
			657.000	
			422.000	
			523.000	
			558.000	
			579.000	
			736.000	
			399.000	
			700.000	
			545.000	
			379.000	
			766.000	
			490.000	
			431.000	
			501.000	
			615.000	
KENT	3.860	7.720	202.381	2.04E-04
	3.878	7.748	161.221	1.26E-04

Cadmium, Lead & Mercury Data from Scrubber/Baghouse

21-Jan-91

	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3	ug/Nm3	ug/Nm3	gr/dscf
FACILITY	@12% CO2	@12% CO2	@12% CO2	@12% CO2
	3.599	7.190	169.953	1.76E-04
	3.927	7.854	236.755	2.81E-04
	3.956	7.913	193.427	8.34E-05
	3.683	7.366	369.144	1.27E-04

	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3	ug/Nm3	ug/Nm3	gr/dscf
	@12% CO2	@12% CO2	@12% CO2	@12% CO2
21-Jan-91				
NUMBER OF SAMPLES	41	66	89	106
DEGREES OF FREEDOM	40	65	88	105
SAMPLE MEAN (XBAR)	3.80	28.55	482.88	3.91E-03
SAMPLE VARIANCE (S^2)	6.73	906.66	152,819.26	1.19E-05
STANDARD DEVIATION (S)	2.59	30.11	390.92	3.46E-03
STD ERROR (S XBAR)	0.41	3.71	41.44	3.36E-04
90% CONFIDENCE (CI 90) LIMIT	4.32	33.35	482.88	4.34E-03
95% CONFIDENCE (CI 95) LIMIT	4.48	34.74	482.88	4.47E-03
MAXIMUM	11.09	199.01	2,974.67	2.11E-02
MEAN + 1.282 STD	7.12	67.15	984.04	8.34E-03
MEAN + 1.645 STD	8.06	78.09	1,125.94	9.60E-03

Cadmium, Lead & Mercury Data from ESP-Equipped OMS Facilities

21-Jan-91

FACILITY	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3 @12% CO2	ug/Nm3 @12% CO2	ug/Nm3 @12% CO2	gr/dscf @12% CO2
ALEXANDRIA	25.756	606.699	349.854	0.015
	34.341	746.169	717.951	
	44.000	1,009.986	576.293	
		487.614		0.0160
		1,906.897		0.0460
		1,011.162		0.0300
		233.710		0.0054
		164.706		0.0048
		450.395		0.0097
		136.751		0.0079
		87.841		0.0063
		170.783		0.0059
HAVERHILL	10.706	150.484	680.041	0.0028
	11.646	103.743	522.060	0.0027
	9.051	232.321	623.561	0.0074
	33.513	35.054	317.413	0.0041
	13.927	240.244	206.819	0.0045
	9.650	190.147	271.281	0.0043
	47.759	472.201	99.213	0.0030
	48.960	470.210	142.765	0.0050
	26.029	635.253	427.360	0.0051
HILLSBOROUGH		518.907	1,552.465	0.0046
		57.378	586.500	0.0051
		458.587	509.817	0.0044
				0.0073
				0.0050
				0.0048
				0.0043
				0.0017
				0.0034
				0.0036
				0.0042
				0.0052
				0.0053
				0.0085
				0.0040
				0.0056
				0.0064

Cadmium, Lead & Mercury Data from ESP-Equipped OMS Facilities

21-Jan-91

FACILITY	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3	ug/Nm3	ug/Nm3	gr/dscf
	@12% CO2	@12% CO2	@12% CO2	@12% CO2
				0.0055
				0.0030
				0.0051
				0.0040
				0.0056
				0.0048
				0.0047
				0.0048
				0.0028
				0.0037
				0.0200
				0.0150
				0.0210
				0.0110
				0.0100
				0.0160
				0.0170
				0.0140
				0.0160
TULSA	428.500	408.700		0.0281
PB & HG	494.800	450.100		0.0211
MEASURED IN	323.000	396.800		0.0241
1 STEACK				0.0122
				0.0093
				0.0069
				0.0145
				0.0203
				0.0247
				0.0054
				0.0056
				0.0036
				0.0095
				0.0094
				0.0086
	1,120.000			
	940.000			
	1,160.000			

Cadmium, Lead & Mercury Data from ESP-Equipped OMS Facilities

21-Jan-91

	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3	ug/Nm3	ug/Nm3	gr/dscf
FACILITY	@12% CO2	@12% CO2	@12% CO2	@12% CO2
		1,240.000		
		710.000		
		450.000		
		510.000		
		750.000		
		670.000		
		740.000		
		1,090.000		
		460.000		
		400.000		
		600.000		
	107.494	243.030		0.0080
	234.988	26.110		0.0101
	106.600	42.640		0.0074
				0.0107
				0.0104
				0.0104

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	CADMIUM	LEAD	MERCURY	TSP
	ug/Nm3	ug/Nm3	ug/Nm3	gr/dscf
	@12% CO2	@12% CO2	@12% CO2	@12% CO2
NUMBER OF SAMPLES	18	44	15	76
DEGREES OF FREEDOM	17	43	14	75
SAMPLE MEAN (XBAR)	111.71	522.38	505.56	0.01
SAMPLE VARIANCE (S^2)	23,363.06	156,816.93	121,711.61	0.00
STANDARD DEVIATION (S)	152.85	396.00	348.87	0.01
STD ERROR (S XBAR)	36.03	59.70	90.08	0.00
90% CONFIDENCE (CI 90) LIMIT	159.73	600.08	626.71	0.01
95% CONFIDENCE (CI 95) LIMIT	174.38	622.75	664.21	0.01
MAXIMUM	494.80	1,906.90	1,552.46	0.05
90TH PERCENTILE (MEAN+1.282 STD)	307.66	1,030.05	952.81	0.02
95TH PERCENTILE (MEAN+1.645 STD)	363.14	1,173.80	1,079.45	0.02

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FACILITY	CADMIUM			LEAD		
	CALCULATED	rvsed conc	rvsed conc	CALCULATED	rvsed conc	rvsed conc
	WT %	@.01gr/dscf	@.015gr/dscf	WT %	@.01gr/dscf	@.015gr/dscf
		(ug/Nm3)	(ug/Nm3)		(ug/Nm3)	(ug/Nm3)
BABYLON						
	0.027	6.552	9.828	0.024	5.862	8.793
	0.018	4.483	6.724	0.073	17.931	26.897
	0.018	4.483	6.724	0.031	7.586	11.379
	0.162	39.794	59.691	1.328	326.271	489.407
	0.147	36.160	54.240	1.236	303.719	455.579
	0.151	37.051	55.576	0.663	162.854	244.281
BRISTOL				0.497	122.034	183.051
				0.166	40.678	61.017
				0.083	20.339	30.508
	0.059	14.592	21.888	0.386	94.949	142.424
	0.009	2.296	3.444	0.255	62.556	93.835
	0.049	12.028	18.042	0.932	229.100	343.650
	0.012	2.969	4.453	1.010	248.329	372.494
	0.023	5.609	8.413	0.033	8.208	12.312
	0.065	15.966	23.949	0.309	75.873	113.809
	0.046	11.360	17.040	1.033	253.794	380.691
	0.121	29.648	44.472	0.303	74.352	111.528
	0.058	14.347	21.521	0.301	74.050	111.074
FAIRFAX	9.76E-02	23.9773	35.9659	0.4176	102.633	153.949
	1.67E-01	41.1245	61.6868	0.7157	175.897	263.845
	1.40E-01	34.4255	51.6380	0.6009	147.687	221.531
	3.44E-02	8.4541	12.6811	0.1245	30.601	45.901
	4.10E-02	10.0788	15.1182	0.1130	27.774	41.661
	4.32E-02	10.6090	15.9136	0.1450	35.637	53.455
				0.7211	177.225	265.837
	1.44E-01	35.3846	53.0768	0.8866	217.905	326.857
	6.47E-02	15.9082	23.8623	0.6592	162.001	243.002
	6.05E-02	14.8809	22.3214	0.2591	63.687	95.531
	5.71E-02	14.0450	21.0675	0.2444	60.062	90.093
	5.91E-02	14.5155	21.7733	0.2531	62.209	93.314
HUNTSVILLE				0.287	70.464	105.696
				0.298	73.219	109.829
				0.256	62.893	94.339
				0.314	77.127	115.690
				0.298	73.222	109.834
				0.239	58.627	87.941
MARION				1.165	286.350	429.525
				0.109	26.868	40.302
				0.234	57.502	86.252

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FACILITY	CADMIUM			LEAD		
	CALCULATED	rvsed conc	rvsed conc	CALCULATED	rvsed conc	rvsed conc
	WT %	@.01gr/dscf	@.015gr/dscf	WT %	@.01gr/dscf	@.015gr/dscf
		(ug/Nm3)	(ug/Nm3)		(ug/Nm3)	(ug/Nm3)
INDIANAPOLIS				0.180	44.180	66.270
				0.059	14.500	21.750
				0.199	48.927	73.391
				0.186	45.676	68.514
				0.170	41.878	62.817
				0.188	46.192	69.288
				0.718	176.493	264.740
				1.767	434.301	651.451
				1.036	254.567	381.851
				0.051	12.543	18.814
				0.049	12.138	18.207
				0.053	13.090	19.635
STANISLAUS	0.040	9.870	14.805	0.449	110.390	165.584
	0.016	3.818	5.727	0.099	24.416	36.623
	0.003	0.649	0.974	0.222	54.545	81.818
	0.024	5.922	8.883	0.501	123.117	184.675
	0.030	7.273	10.909	0.431	105.974	158.961
	0.021	5.117	7.675	0.367	90.130	135.195
	0.050	15.833	23.750	0.735	233.333	350.000
	0.034	10.833	16.250	0.782	248.333	372.500
	0.047	15.000	22.500	0.664	210.833	316.250
KENT	0.948	232.218	348.327	1.890	464.436	696.654
	0.949	233.303	349.954	1.896	466.067	699.101
	0.881	216.504	324.756	1.760	432.506	648.760
	0.961	236.242	354.363	1.922	472.484	708.727
	0.968	238.007	357.010	1.937	476.013	714.020
	0.901	221.545	332.318	1.803	443.090	664.635

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	CADMIUM			LEAD		
	CALCULATED WT %	rvsed conc @.01gr/dscf (ug/Nm3)	rvsed conc @.015gr/dscf (ug/Nm3)	CALCULATED WT %	rvsed conc @.01gr/dscf (ug/Nm3)	rvsed conc @.015gr/dscf (ug/Nm3)
NUMBER OF SAMPLES	41	41	41	66	66	66
DEGREES OF FREEDOM	40	40	40	65	65	65
SAMPLE MEAN (XBAR)	0.1889	46.6555	69.9832	0.5623	140.5792	210.8688
SAMPLE VARIANCE (S^2)	0.10	6010.82	13524.35	0.30	18725.13	42131.53
STANDARD DEVIATION (S)	0.3159	77.5295	116.2942	0.5520	136.8398	205.2597
STD ERROR (S XBAR)	0.0493	12.1081	18.1621	0.0679	16.8438	25.2657
90% CONFIDENCE (CI 90) LIMIT =	0.2532	62.4335	93.6503	0.6503	162.3903	243.5854
95% CONFIDENCE (CI 95) LIMIT =	0.2720	67.0406	100.5609	0.6758	168.6983	253.0474
MAXIMUM	0.968	238.007	357.010	1.937	476.013	714.020
MEAN + 1.282 STD	0.594	146.048	219.072	1.270	316.008	474.012
MEAN + 1.645 STD	0.709	174.191	261.287	1.470	365.681	548.521

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FACILITY	CADMIUM			LEAD		
	CALCULATED	rvsed conc	rvsed conc	CALCULATED	rvsed conc	rvsed conc
	WT %	@.01gr/dscf	@.015gr/dscf	WT %	@.01gr/dscf	@.015gr/dscf
		(ug/Nm3)	(ug/Nm3)		(ug/Nm3)	(ug/Nm3)
ALEXANDRIA	0.0715	17.561	26.341	1.6831	413.659	620.488
	0.0953	23.415	35.122	2.0700	508.752	763.128
	0.1221	30.000	45.000	2.8019	688.627	1032.941
				1.2400	304.759	457.139
				1.6867	414.543	621.814
				1.3714	337.054	505.581
				1.7610	432.797	649.195
				1.3962	343.137	514.706
				1.8892	464.325	696.488
				0.7043	173.102	259.654
				0.5673	139.430	209.145
				1.1778	289.463	434.194
HAVERHILL	1.56E-01	38.2343	57.3514	2.1868	537.444	806.166
	1.76E-01	43.1331	64.6997	1.5634	384.232	576.348
	4.98E-02	12.2305	18.3457	1.2774	313.947	470.921
	3.33E-01	81.7396	122.6094	0.3479	85.498	128.247
	1.26E-01	30.9493	46.4239	2.1722	533.875	800.813
	9.13E-02	22.4426	33.6639	1.7992	442.202	663.304
	6.48E-01	159.1957	238.7935	6.4043	1574.002	2361.004
	3.98E-01	97.9194	146.8792	3.8264	940.421	1410.631
	2.08E-01	51.0377	76.5565	5.0681	1245.595	1868.392
HILLSBOROUGH				4.5898	1128.059	1692.088
				0.4578	112.506	168.760
				4.2407	1042.242	1563.364
TULSA PB & HG MEASURED IN 1 STEACK	6.20E-01	152.4911	228.7367	0.5918	145.445	218.167
	9.54E-01	234.5024	351.7536	0.8679	213.318	319.976
	5.45E-01	134.0249	201.0373	0.6699	164.647	246.971
	5.47E-01	134.3677	201.5516	1.2361	303.788	455.682
	9.47E-01	232.6617	348.9926	0.1052	25.851	38.777
	5.86E-01	144.0544	216.0816	0.2345	57.622	86.433

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	CADMIUM			LEAD		
	CALCULATED WT %	rvsed conc a.01gr/dscf (ug/Nm3)	rvsed conc a.015gr/dscf (ug/Nm3)	CALCULATED WT %	rvsed conc a.01gr/dscf (ug/Nm3)	rvsed conc a.015gr/dscf (ug/Nm3)
NUMBER OF SAMPLES	18	18	18	30	30	30
DEGREES OF FREEDOM	17	17	17	29	29	29
SAMPLE MEAN (XBAR)	0.3707	91.1089	136.6633	1.8663	458.6780	688.0171
SAMPLE VARIANCE (S^2)	0.09	5331.66	11996.24	2.35	142156.72	319852.62
STANDARD DEVIATION (S)	0.2971	73.0182	109.5273	1.5341	377.0368	565.5551
STD ERROR (S XBAR)	0.0700	17.2106	25.8158	0.2801	68.8372	103.2558
90% CONFIDENCE (CI 90) LIMIT =	0.4640	114.0506	171.0758	2.2335	548.9236	823.3854
95% CONFIDENCE (CI 95) LIMIT =	0.4925	121.0484	181.5726	2.3422	575.6393	863.4589
MAXIMUM	0.954	234.502	351.754	6.404	1,574.002	2,361.004
MEAN + 1.282 STD	0.752	184.718	277.077	3.833	942.039	1,413.059
MEAN + 1.645 STD	0.859	211.224	316.836	4.390	1,078.904	1,618.355



Institute of Resource Recovery
Testimony Before The
National Air Pollution Control Techniques Advisory Committee
Research Triangle Park, North Carolina

January 31, 1991

By

David Beachler
Chairman, IRR Technology and Data Assessment Committee
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Washington, D.C. 20036

Manager, Environmental Quality Engineering
Westinghouse Electric Corporation
2400 Ardmore Boulevard
Pittsburgh, Pennsylvania 15221

Municipal Waste Combustor Standards

My name is David Beachler, Chairman of the Institute of Resource Recovery's Technology and Data Assessment Committee. The IRR is an institute of the National Solid Wastes Management Association (NSWMA), a trade association with over 2,500 members of the private waste services industry. The IRR represents firms that design, build and operate facilities to recover energy and materials from trash while reducing its volume through controlled combustion. IRR has been active with the U.S. Congress, EPA, and other Executive Branch agencies in seeking to establish sound national environmental policy in the solid waste area.

IRR appreciates the opportunity to be here today to provide comments relating to the Clean Air Act Amendments (CAAA) of 1990. My discussion will focus on:

- 1) Whether Best Demonstrated Technology (BDT) represents Maximum Achievable Control Technology (MACT);
- 2) How EPA should proceed toward the development of specific emissions standards (limits); and
- 3) The role IRR would like to play in this important process.

Let me begin by emphasizing that proper regulation of Municipal Waste Combustors (MWCs), along with all other waste management options, is essential for the protection of public health and the environment. We all need to be fully confident in the methods used to manage our nation's wastes.

Toward this end, the recently promulgated New Source Performance Standards and Emissions Guidelines (NSPS/EG) have addressed the emissions from new and existing MWC facilities in an appropriate way. The NSPS/EG are the most stringent and complex regulations that EPA has ever developed under Section 111 of the Clean Air Act. The Agency has never before required retrofits of this magnitude on existing facilities. As a result, MWCs are the most regulated industrial source in the United States today.

BDT As MACT

In addressing the issue of whether EPA's recently promulgated BDT standards represent MACT, as defined by the CAAA, let me first focus on new MWCs. It is the opinion of IRR that the BDT standards for new units do reflect MACT as defined by the CAA. Among the MWCs with unit capacities greater than 250 tons per day, a majority are equipped with a combination spray dryer absorbers and fabric filters or ESP's as air pollution control devices. The best of these achieve emissions limitation equal to those promulgated as BDT in the NSPS. Consequently, no changes to the promulgated NSPS should be required to comply with the CAAA MACT. The picture surrounding emission guidelines for existing MWCs is less clear.

By definition, MACT for existing sources must be at least as stringent as the average emissions limitation achieved by the best-controlled 12 percent of similar sources -- excluding sources that achieved an emissions level meeting a "lowest achievable emissions rate" standard within 18 months before the MACT standard was proposed or 30 months before it is issued. In determining MACT, EPA must consider the reasonableness of requiring maximum reductions in toxic emissions, taking cost, energy, and other non-air impacts into account. It is this latter requirement which bears particular attention.

While it may not be entirely clear whether the promulgated BDT requirement for "large" existing MWCs is as stringent as the MACT mandate, it certainly is for the "very large" facilities. EPA has completed a rigorous technology and cost effectiveness analysis during the Section 111 rule-making process which IRR believes fulfills the intention of Congress in determining MACT for both "large" and "very large" plants. IRR appreciates EPA's obligation to revisit this issue per CAAA mandate. At the same time, IRR is concerned that any new round of regulations for existing MWCs would be too stringent and costly to justify the minimal emissions reduction which may be gained.

The bottom-line is that the MWC industry has just been subject to three years of intensive rule-making. Requirements above and beyond these standards are difficult to justify at the present time. Bearing these concerns in mind, IRR nonetheless would welcome an open and fully cooperative dialogue with EPA as the process of determining what constitutes MACT for existing MWCs proceeds.

Mercury Emissions Standards

The IRR has previously submitted comments on mercury emissions standards to the docket. A copy of our October submittal will be attached to my written statement. Given that the Agency has not provided any new technical data since October, IRR's concern about the prospect of a numeric or percent reduction mercury standard for MWCs has not diminished.

In light of the CAAA requirement for the development of a mercury emission standard, it is wholly reasonable for the Agency to recommend a standard which fully accounts for the many uncertainties still surrounding both the control technologies and management practices aimed at controlling mercury emissions. At a minimum, EPA should refrain from imposing a mercury standard based on the limited experience of any country outside the U.S., and should require a limit which will encourage further control technology research and development. Imposing a standard before full verification of management practices, testing methodologies, etc. can be accomplished will only serve to undermine the viability of an essential component of this nation's solid waste management strategy.

Summary

The IRR recognizes the need for the Agency to modify MWC standards for lead, cadmium, and mercury, to be consistent with the CAAA. We stand ready to work with EPA to fulfill the requirements set forth in the CAAA and are confident that this may be accomplished reasonably and effectively without going overboard. In particular, any modified standards for MWCs need to be flexible enough to accommodate cost considerations, the remaining uncertainty surrounding emissions testing methodologies, and other significant factors.

October 19, 1990

Mr. Fred L. Porter
Air Docket (LE - 131)
Attention Docket No. A-89-08
Room M1500
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Dear Mr. Porter:

The Institute of Resource Recovery (IRR), a component of the National Solid Wastes Management Association, is pleased to submit comments on EPA's supplemental information on mercury (Hg) emissions from municipal waste combustors (MWCs)..

As will be further detailed in our attached comments, the IRR has serious concerns about the prospect of the Agency developing numeric or percent reduction Hg standards at the present time. Based on the data presented in the docket, such a decision would be based on a limited database from Europe and Canada, using test methodologies that are neither fully verifiable or applicable to MWCs in the U.S. (i.e., since the EPA is proposing a different test methodology).

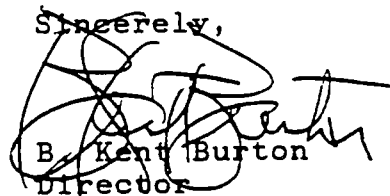
The prospect of the Agency developing the same Hg emission standard for new and existing MWCs is troublesome as well. Hg emissions tests completed to date on MWCs with dry scrubbers in the U.S., Canada, and Europe have not yielded consistent, guaranteeable results. Further, not enough is known about the conditions under which the European and Canadian data presented in the docket was collected. Likewise, the EPA-approved Hg testing methodology used on U.S. MWCs has yet to be validated.

As a result of these inconsistencies and deficiencies, the Agency should not recommend numeric or percent reduction Hg standards for MWCs at this time. There is a clear need to test a full-range of U.S. MWC technologies, with selected best demonstrated technology (BDT) air pollution control systems, and under all operating conditions. Only after obtaining and analyzing these data would it be appropriate to develop such standards.

Mr. Fred L. Porter
Air Docket (LE - 131)
Attention Docket No. A-89-08
Page Two

The IRR welcomes the opportunity to work with EPA toward the development of responsible Hg emissions standards for MWCs. Such standards need to be fully demonstrated, achievable on a guaranteeable basis, and economically viable. Please let me know how the IRR can be of further assistance.

Sincerely,



B. Kent Burton
Director

Attachments

INSTITUTE OF RESOURCE RECOVERY COMMENTS
ON EPA'S SUPPLEMENTAL MERCURY EMISSIONS DATA
OCTOBER 19, 1990

Existing Data

- * The Docket and Federal Register notice indicates that EPA will be establishing an emission limit for Hg for both new and existing MWCs. The supporting data for this decision appears to be from select facilities using three different control technologies (sodium sulfide, activated carbon, and wet scrubbers). None of these MWCs are located in the U.S., and there are no data presented in the Docket on environmental, economic or energy trade-offs.
- * The IRR is concerned about EPA's inclusion in the Docket of European and Canadian Hg emissions test data, particularly if these are the only basis on which the Agency intends to determine Hg emissions standards for MWCs. There is real doubt about whether U.S. MWCs will be able to achieve and maintain compliance with Hg standards suggested by these data. IRR has no confidence in these data. Little is known about the conditions under which these Hg emissions tests were conducted (e.g., waste stream, whether the plants have good combustion practices or not, sorbent system details and operations). Also, there are still questions to be resolved concerning the testing methodologies used to complete these tests, and the associated bias of the data. Given the estimation that approximately three times as much Hg is present in the U.S. waste stream than in the European waste stream, any application of European test results to U.S. MWCs is further questioned.

In addition, the test methodology used for these tests is different than the U.S. EPA sampling procedure. Given this, how can EPA base a U.S. standard on these numbers? There is a definite need for the Agency to take a comprehensive look at all U.S. MWC technologies, with different BDT for new and existing air pollution control systems, under all operating conditions, prior to the establishment of numeric or percent reduction Hg emissions standards for MWCs.

- * EPA indicates it may require the same Hg emissions limit for new and existing MWCs in the U.S. The "Emissions Guideline" (EG) proposed retrofit of existing units with duct or furnace injection of dry sorbent for acid gas control, good particulate control, and "good combustion practices" for control of organics. Yet all the Hg sorbent techniques listed in the Docket were from units with dry injection with humidification, Flakt Spray Dryer Absorbers (SDA), Niro SDA, or one wet system on older MWCs (which could have had carbon carry-over from poor combustion).

There are no data to indicate that existing MWCs will be able to meet the same Hg emission limit as new MWCs without the same emission control train (i.e., SDA, fabric filter/ESP). The requirement for SDA retrofit on existing units was deemed inappropriate in the EG. Does EPA now plan to require SDA on existing units? If so, the Agency does not seem to have examined the cost implications of this action.

Hg Testing Methods

- * The IRR is concerned about the accuracy of the method 101A Hg sampling train and the EPA multi-metals testing method, expected to be used by the Agency as the basis to determine Hg emissions levels from MWCs. While EPA method 101A may have been validated for sewage sludge combustors, the same is not true for MWCs. A recent international literature search has resulted in the documentation of clear problems associated with the EPA Hg testing methods when employed at MWCs. These data will be submitted independently by an IRR member.

Many scientists believe that there may be some interference with the analytical testing technique because of chlorides present in the flue gas. As a result, the reported Hg emission data may have an associated bias and, in fact, the entire existing database may not be meaningful. EPA's own Office of Research and Development seems to support this since it is still in the process of validating its Hg testing methods. Consequently, it is clear that Hg standards should not be established prior to proper review and verification of these testing methods. Refer to the Docket and EPA's own method validation work sponsored by the Agency's Office of Solid Waste. None of these validations were conducted using MWC flue gas. IRR understands that David White with Radian agreed to enter this into the Docket following our October 17, 1990 meeting with EPA.

- * Actual Hg emissions test results from the Detroit, Michigan MWC facility have shown major inconsistencies with both the multi-metals and 101A Hg sampling train testing methods. Key conclusions reached by Roy F. Weston, managers of the tests, were: 1) Neither methodology can be verified at the present time with any degree of accuracy or certainty; 2) New testing methods need to be explored; and 3) EPA should delay any intentions to propose numeric or percent reduction Hg emissions standards for MWCs.

Hg Control Technologies

- * The use of sodium sulfide as an additive to sorbent or duct injection systems results in the creation of mercuric sulfide. Systems equipped with ESPs have not demonstrated an ability to effectively capture small particles. EPA does not have data to support the development of numeric or percent reduction Hg standards using sodium sulfide as an additive to control Hg emissions from ESP-equipped MWCs. Since all existing MWCs using sodium sulfide injection are equipped with dry sorbent injection/fabric filter systems, definite uncertainty exists regarding the applicability of these control technique to other air pollution control device configurations as well (e.g., spray dryers and fabric filters).
- * Activated carbon injection has only been applied to a few European plants and there are only limited data existing regarding its effectiveness in removing Hg from flue gas. The test results as reported by Joy Technologies for three MWCs in Europe show some inconsistencies with the theory that lower SDA outlet temperatures result in lower Hg emissions. Also, some of the data indicate that adding carbon does not necessarily result in lower Hg emissions, as shown by the data reported from the Amager facility.

The use of activated carbon as an additive to sorbent or duct injection systems results in a small amount of absorbed Hg on an activated carbon particle (i.e., because of the higher temperature). Systems equipped with electrostatic precipitators (ESPs) (without dry scrubbers) have not demonstrated an ability to effectively capture these particles of low resistivity. EPA does not have any data to support the development of numeric or percent reduction Hg standards using activated carbon as an additive to control Hg emissions from ESP-equipped MWCs.

- * IRR is concerned about EPA's reliance, in the Docket, on wet scrubbing data from only one vendor source. From the limited data available it is not clear that mercury control occurs across the existing air pollution control device or across the air pollution control device augmented with the wet scrubber. These data are not sufficient for EPA to propose numeric or percent reduction Hg standards for MWCs at the present time. EPA should consider all of the available data from MWCs equipped with wet scrubbers. For example, refer to the attached paper by Kunihiro Nakazato presented at the ASME 1990 National Waste Processing Conference.

These and other data should be made available in the Docket and be used to better determine whether wet scrubbing technology is an appropriate approach to control Hg emissions from new and existing MWCs. Absent any conclusive data, IRR has major reservations about any requirement by EPA to retrofit U.S. MWCs with wet scrubbing systems (i.e., due to extreme cost considerations and multi-media impacts such as lower plume rise, and possible increases in dioxin tef emissions -- refer to the attached paper by Vogg, Hunsinger, and Stieglitz on dioxins).

More specifically, requiring the application of wet scrubbers to large-scale MWCs will likely result in the following adverse impacts: 1) Environmental impact -- due to the significant increase in the consumption of precious water resources, which in turn would require many MWCs to add a discharge to surface waters (as a result of the need to manage an increased amount of waste waters); 2) Impact to wetlands -- may occur due to increased MWC plot size and the need for settling ponds or discharges; 3) Energy consumption -- resulting from flue gas reheat to assure the reliability of flue components and air dispersion. Also, the pumping of fluids will constitute significant consumption of electrical power; and 4) Space consumption -- resulting from the inclusion of additional flue gas cleaning equipment, pumping and piping systems, and water treatment facilities (inclusive of buildings and settling ponds). Many existing MWCs would not have available space for wet scrubber retrofits because of site constraints.

- * IRR is concerned that EPA is giving too much credence to the advice of Hg emissions control technology vendors. While such vendors may claim that their systems (e.g., activate carbon, sodium sulfide, and wet scrubbers) are technically reliable and capable of achieving desired results, none are likely to guarantee consistent, long-term performance. With no established track record, and no vendor willing to guarantee their systems, it is the municipalities across the U.S. who would bear the liability of any ramifications for not being able to comply with prematurely-established Hg standards.

Hg Source Reduction

- * The variability of emissions data indicates that Hg content in MSW is highly variable. When emissions for a single substance are fairly constant, experience indicates a ubiquitous distribution of constituent in the MSW. With Hg, the indication is that the emissions result from only a few specific Hg-containing items (e.g., batteries, florescent light bulbs, certain electrical items, etc.). Based on this, it would be a better control strategy to require removal of Hg from these products by the manufacturer or removal of the products from the waste stream at the household level.

With this strategy, Hg could be eliminated rather than be controlled. By using a control technology approach, Hg is moved from the flue gas to the ash or to another form. It still exists and must still be properly managed. By comparison, if Hg is eliminated from the waste stream there is no longer any issue. Hg in the waste stream poses a problem not only for MWCs, but for recycling, landfilling, and other disposal methods as well. If EPA sets Hg standards only for MWCs, a majority of the waste stream would not be controlled. The elimination of Hg from products would solve this dilemma as well.

Even though the current uncontrolled levels of Hg emissions from MWCs are well below the health effect threshold, IRR recommends that EPA continue to pursue a requirement for the removal of Hg-bearing products from the waste stream now, measure the reduction in emissions over a two year period, and then assess the need for an emission limit based on add-on control technology. Targeted removal of Hg from the waste stream was the approach taken by EPA in its 12/20/89 proposal, and nothing has happened to alter that position now.

Environmental Impact

- * In response to the allegation by some environmental organizations that a direct link may be drawn between Hg emissions from MWCs and the contamination of fish and other wildlife, no definitive evidence bears this out. A recent workshop on mercury in the environment, sponsored by the State of Florida (June 20 - 21, 1990, at FL State University in Tallahassee), addressed this issue. Scientists, state officials, Florida State University researchers, and other experts concluded that the single largest contributor of Hg into the Florida environment is decaying peat moss found in the Everglades. The release of mercury from this decaying process has been expedited as a result of the lowering of the water tables in the Everglades.

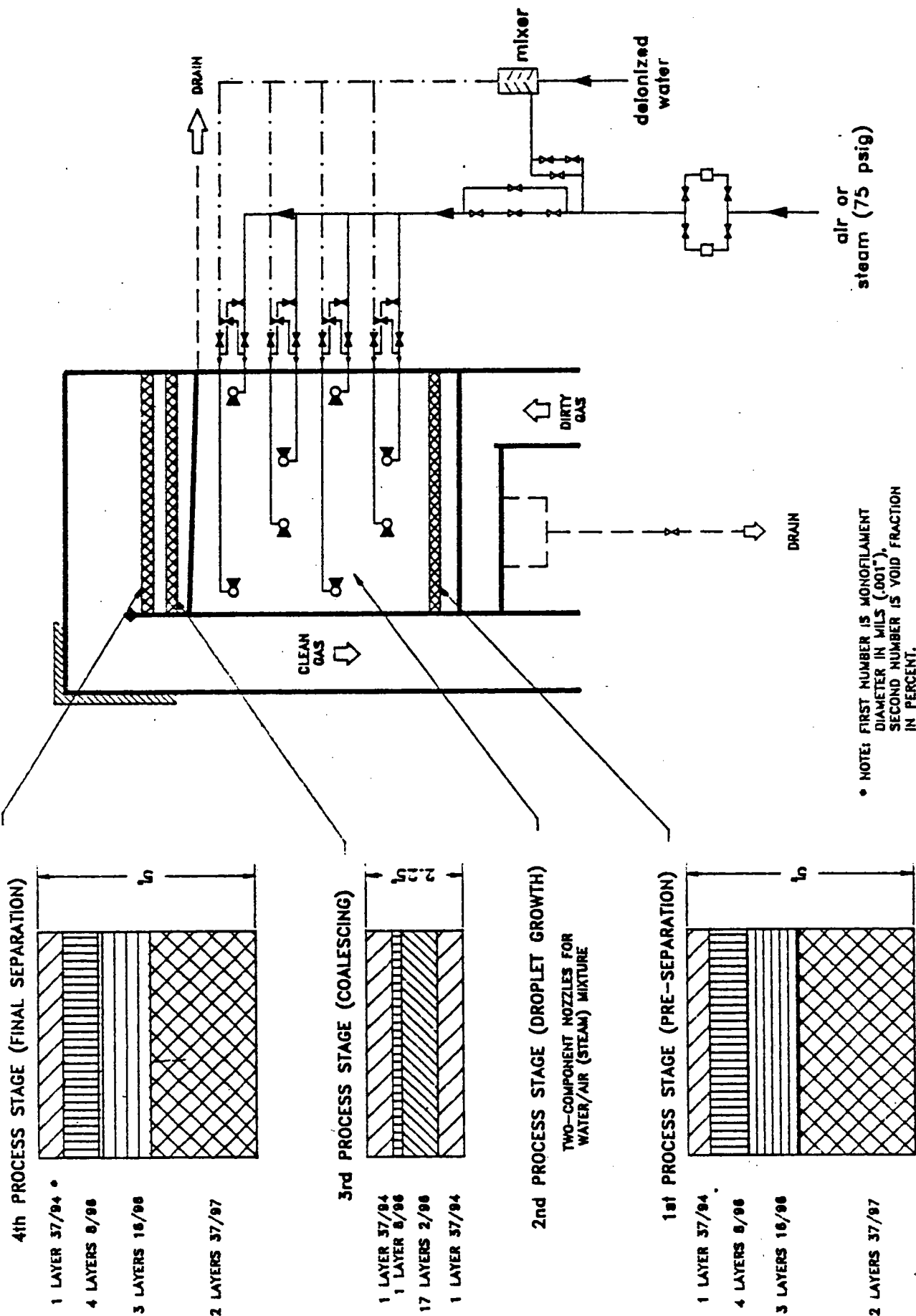
U.S.E.P.A.
NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE

JANUARY 31

NESHAP BASED ON MACT-MUNICIPAL WASTE COMBUSTORS

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AEROSEP™ Multiple Stage Aerosol Separation System (Typical Configuration)



MUNICIPAL GARBAGE INCINERATION SYSTEM

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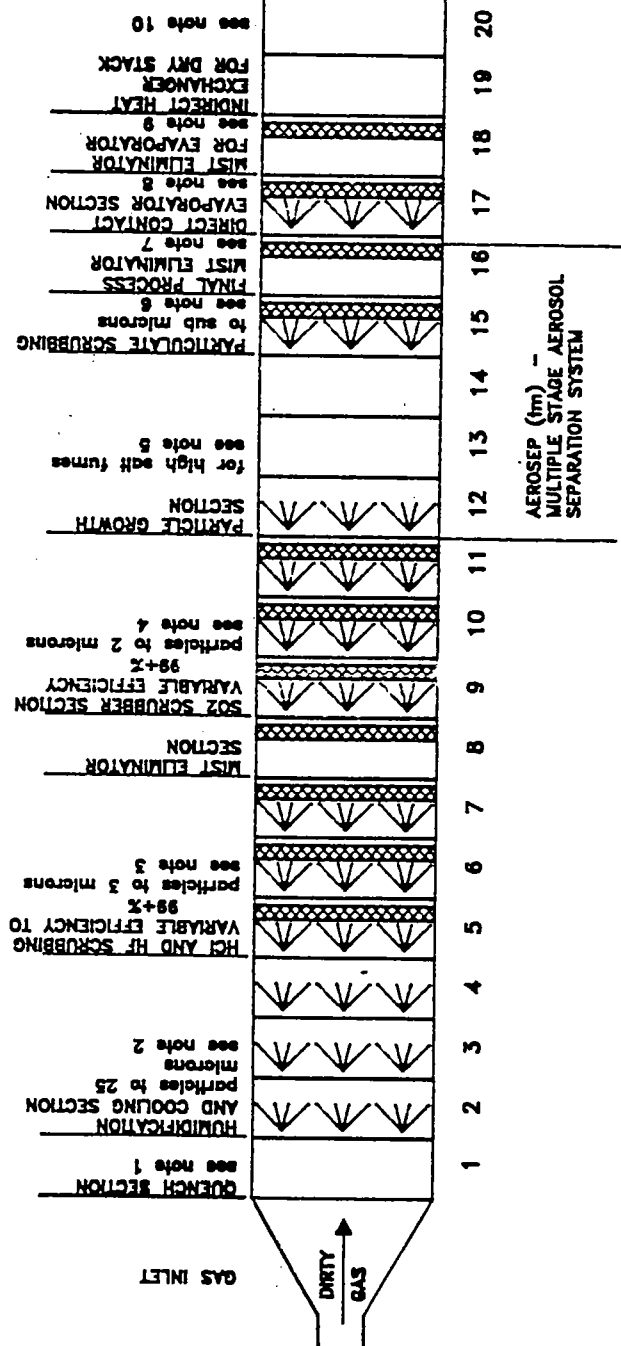
FLUE GAS CLEANING PROCESS

TO PROVIDE

CLEAN AND DRY STACK GAS

COMMENTS: - ONLY GAS LINE SHOWN
- MODULAR DESIGN ALLOWS ADJUSTMENT FOR DIFFERENT WASTE STREAMS
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COMBUSTION STREAM WOULD REQUIRE THIS EXTREME.

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STATE-OF-THE-ART
INCINERATOR SCRUBBER

ATTACHMENT 1

U.S. Proposed MWC Standards vs. European MWC Practice

	U.S. . Proposed	Gothenburg Sweden	Munich (North) Germany	Bremerhaven Germany
Tons Per Day	250-2200	800	240	820
HCl, ppm	200	8	4	4
SO ₂ , ppm	100	--	15	45
HF, ppm	Not Regulated	0.4	< 1	2
Particulate, mg/nm ³	69	10	10	20
Mercury, mg/nm ³	Not Regulated	0.1	Not Regulated	Not Regulated
Dioxins, mg/nm ³	Not Regulated	0.1	--	--

"Design Considerations for MSW Incinerator APC Systems Retrofit" by J.R. Donnelly, Davy Environmental. Presented at AWMA Annual Meeting, 6/24-6/29/90.

/str:WMS-55/PC5

F: G&A/US EPA

Gotheburg, Sweden

	IN	OUT	AMOUNT SEP. %
Dust mg/Nm3 dry gas	30-55	12-19	50-80
Hydrochloric acid HCl mg/Nm3 dry gas	550-1050	5-19	98-99
Hydrofluoric acid HF mg/Nm3 dry gas	2-5	0.2-0.6	80-90
Sulphur oxides SOx mg/Nm3 dry gas	90-220	90-219	0-10
Mercury Hg ug/Nm3 dry gas	150-500	10-45	85-95
Cadmium Cd ug/Nm3 dry gas	30-50	10-20	30-70
Dioxins and dibenzofurans TCDD equiv. ng/Nm3 dry gas at 10% CO2	1.5	0.1	93

Kimre, Inc.

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Municipal Waste Incinerator Gothenburg, Sweden

Process

Over 300,000 tons of municipal waste a year are treated by the Savenas incineration plant erected in 1972 near Gothenburg, Sweden. 1987 saw the start of the construction of a 2-stage flue gas-cleaning system for each of the three lines with integrated heat pumps for heat recovery supplying hot water to the heating network of the Gothenburg Energy Department.

This additional gas cleaning system was supplied by Gotaverken Energy Systems AB in Gothenburg, Sweden; the scrubbers were designed and fabricated by Teiko Engineering AB in Helsinki, Finland.

Gas volume

Each of the three incineration lines produces approximately 60,000 SCFM flue gas at an average temperature range of 85-95 degrees F.

Problems

The partly toxic dusts as well as aerosols developed during the incineration or the subsequent wash process are insufficiently removed by the existing electrostatic precipitator and the new packed towers for the flue gas cleaning.

Specifications

The expected dust and aerosol loading before the 2-stage scrubbers was approximately .044 gr/SCF with 40 wt% being smaller than 2 microns, 20 wt. % smaller 1 micron and 7 wt.% smaller than 0.7 microns. This was to be reduced to a total amount of maximum .006 gr/SCF.

Solution

A 2-stage separation system designed by Kimre's European licensee, the Environmental Control Department of Symalit Co. Ltd. using a sprayed washing stage followed by an entrainment separator was installed in the autumn of 1987.

Results

For the given operating conditions, an outlet dust loading below .006 Gr/SCF was guaranteed. The calculated pressure drop of the 2-stage aerosol separator was 2.4-2.8 in WC. The first line went into operation in the early summer of 1988.

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TELEFAX: 305-233-8687

Municipal Waste Plant Bremerhaven, Germany

Process

In 1972 the Environmental Control Department of Von Roll AG, Zurich, Switzerland, erected a 3-line incinerator plant with an incineration capacity of 10 tons/hr of municipal waste. In the integrated scrubber stages the gases are first quenched to the dew-point temperature and the gas phase pollutants, such as HCl, HF, and SO₂, are removed in the following gas absorption stage.

In 1987, one of the three lines was equipped with an additional Denox-system for the absorption stage.

Gas volume

The above-mentioned incinerator line has a gas rate of approximately 48,000 CFM at an average temperature range of 150-160 degrees F.

Problems

The generation of reaction aerosols - mainly resulting from the reaction of fluorides and chlorides - cannot be sufficiently avoided in the different process steps. These aerosols can be present in concentrations of up to 0.09-.11 gr/SCF in the flue gas.

Specifications

The aerosols, of which 25-30 wt.% are expected to lie in the range of 0.3-0.4 micron have to be reduced to <.004 gr/SCF.

Solution

Kimre's European licensee, the Environmental Control Department of Symalit Co. Ltd. designed and delivered a special 3-stage version of the AEROSEP(TM) Multi Stage Aerosol Removal System. This high-efficiency removal system consists of gas conditioning and agglomeration stages which ensure that the necessary emission limits are achieved.

Results

Measurements made up to date have been extremely positive. Further optimization of the Denox-process was successfully completed during the second half of 1988.

The pressure drop of the three-stage removal system is in the range of 5 in. WC. This is lower than the specified operating conditions.

	Proposed U.S.*	Goth., SWEDEN	Munich, GERMANY	Bremer., GERMANY
Tons Per Day	>200	800	240	820
HCl, ppm	200	8	4	4
SO ₂	100	--	15	45
HF, ppm	Not Reg.	0.4	< 1	2
Particulate, mg/nm ³	69	10	10	20
Mercury, mg/nm ³	Not Reg.	0.1	Not Reg.	Not Reg.
Dioxins, g g/nm ³	Not Reg.	0.1	--	--

* Per Davy McKee, June 24, 1990

COMMENTS OF WHEELABRATOR ENVIRONMENTAL SYSTEMS INC.
BEFORE THE NATIONAL AIR POLLUTION CONTROL
TECHNIQUES ADVISORY COMMITTEE

RESEARCH TRIANGLE PARK, NORTH CAROLINA

JANUARY 31, 1991

BY

DR. RICHARD F. ANDERSON
DIRECTOR OF GOVERNMENT AFFAIRS

WHEELABRATOR ENVIRONMENTAL SYSTEMS INC.
LIBERTY LANE
HAMPTON, NEW HAMPSHIRE 03842

I am pleased to offer these comments on behalf of Wheelabrator Environmental Systems Inc. (WESI) regarding modifications to standards applicable to municipal waste combustors (MWCs). WESI is a leading provider of waste-to-energy services in the United States. WESI designs, constructs, operates and owns waste-to-energy facilities. Currently, WESI operates 11 facilities in seven states; is constructing three more facilities; and, is in the permitting process for another three projects. WESI operations experience in the large, commercial waste-to-energy industry has been continuous and growing since 1975 when the Saugus, Massachusetts facility first came on-line. WESI appreciates the opportunity to discuss industry standards with NAPCTAC and the U.S. Environmental Protection Agency (EPA).

My comments today are primarily concerned with the contents of the summaries of information related to cadmium, lead and mercury emission rates and control technologies applied to MWCs. They also are directed generally to mass burn facilities. WESI recognizes the fact that the Clean Air Act Amendments of 1990 (CAAA) require EPA to set numeric emission standards for cadmium, lead and mercury, as well as seven other pollutants including particulate matter. In the past, many in the industry and some regulators have acknowledged that good particulate control was an efficient and environmentally responsible way to minimize metals emissions. However, the CAAs do not allow EPA to use the control of particulate matter (PM) as a surrogate for metals

emissions control. Yet, because the relationship between PM emissions and metals emissions is strong, it may be impossible to develop numerical standards for one without imposing a de-facto surrogate emission standard for the other.

We have analyzed emission data from a number of WESI facilities, and compared them to the summary documents prepared for the EPA and reported in the NAPCTAC briefing materials. Our data base offers a larger sample size than the EPA has perused -- and we would like to share this with you today and over the next few months. The findings from these analyses are offered in the spirit of cooperation in order to help the Agency develop emission standards based on good science.

MAJOR COMMENTS AND FINDINGS

General

1. Condensation of the less volatile metals such as Cd and Pb occurs after the furnace but before the scrubber vessel; thus, the PM control device will determine what level of metals collection is possible.
2. Generally speaking, PM emission rates are statistically correlated with both Cd and Pb emission rates.

3. It may be impossible to set a numerical emission limit for Cd or Pb without setting a de-facto surrogate standard for PM.
4. EPA has presented a large group of data for MWC units using different combustion technology and various air pollution control configurations. However, when the data are carefully screened there is relatively few data points where PM, Cd and Pb are simultaneously measured. In developing emission limit, EPA's reliance on non-measured data is flawed, and does not provide a technically credible background upon which to set emission limits where non-compliance may result in violations, fines, and even shut-down.
5. By focusing on low PM, low metals emission test results clusters, EPA may be ignoring actual data distributions which must be accurately considered in setting emission standards.

Cadmium Emission Limits

6. PM and Cd emission rates in SDA/ESP and ESP systems exhibit a moderately strong statistical linear relationship. The hypothesis that when PM is at or below 0.010 gr/dscf, Cd emissions rates will be below 20 µg/dscm is rejected by

analysis of combined WESI-EPA data. There exists a Region of Compliance Concern over 20 μg Cd in the PM range of 0.010 - 0.015 gr that has a high probability of pollutant measurement occurrence. In this PM range, Cd emission rates may be expected to fall between 32 - 47 $\mu\text{g}/\text{dscm}$. This range is more than twice the suggested 20 μg limit.

7. Combined WESI and EPA Cd emission data, when evaluated independent of PM emissions, has an upper 95% confidence interval of 84.3 $\mu\text{g}/\text{dscm}$.
8. A PM emission limit of 0.03 gr/dscf applicable to existing MWCs with aggregate capacity of 250 to 1,100 TPD will have great difficulty in meeting a 20 $\mu\text{g}/\text{dscm}$ Cd standard.
9. WESI facilities using FF for PM control have yielded non-detects for Cd in almost every case. These data cannot confirm or reject EPA's hypothesis that a linear relationship exists between PM and Cd in FF systems.
10. The detection level for at least one Cd non-detect found at Bridgeport was critically close to the 10 $\mu\text{g}/\text{dscm}$ emission limit identified by EPA for discussion. EPA should investigate the implication of test method error bands when non-detect samples closely approximate a suggested emission limit.

11. When EPA's data are screened for cases of actual simultaneous measurement of PM and Cd in FF systems, the Long Beach test campaign results clearly contradict the hypothesis that when PM is below 0.010 gr, Cd is below 10 μg .

Lead Emission Limits

12. PM and Pb emission rates in SDA/ESP and ESP systems exhibit a moderately strong statistical linear relationship. The hypothesis that when PM is at or below 0.010 gr/dscf, Pb emission rates will be below 300 $\mu\text{g}/\text{dscm}$ is rejected by analysis of combined WESI-EPA data. The Region of Compliance Concern over 300 $\mu\text{g}/\text{dscm}$ of Pb in the PM range of 0.010 - 0.015 gr/dscf has a high probability of pollutant measurement occurrence. Test results can normally expect to fall within the Cd range of 811-1,231 μg when PM ranges from 0.010 - 0.015 gr.
13. When combined WESI and EPA Pb emission rates are evaluated independent of PM emission rates, the upper 95% confidence interval is 2,374 μg . This is nearly 8 times the suggested 300 μg emission limit.

14. Facilities using FF control systems achieve very good Pb-PM control. Most test results yield non-detects for Pb emission rates.
15. EPA's hypothesis that Pb-PM emission rates are linearly related does not enjoy strong statistical support. Combining WESI and EPA data results in a weak positive correlation. The relationship may exist, but more actual simultaneous measurement data need to be generated and analyzed to confirm the relationship.
16. The general lack of data makes it impossible to confirm or reject the hypothesis that Pb emissions are below 100 μ g when PM emissions are at or below 0.010 gr in FF systems.

Mercury Emission Limits

17. The mercury load in U.S. MSW waste is statistically significantly higher than the mercury load in European MSW. U.S. mercury load in MSW is slightly more than twice the mercury load in European MSW, based on inlet emission data.
18. The EPA is urged to conduct experiments involving flue gas additives in SDA/FF, SDA/ESP, and ESP systems to determine what levels of mercury control are constantly achievable.

I. CADMIUM EMISSION STANDARDS AND CONTROL TECHNOLOGY FOR NEW AND EXISTING MWCS

A. Existing Facilities with ESPs and SDA/ESPs

The EPA consultant report states that recently built Spray Dry Absorber/ESP (SDA/ESP) systems that exhibit PM emission rates of roughly 0.010 gr/dscf generally emit cadmium at concentrations below 20 µg/dscm. This statement implies two hypotheses. First, if PM is at or below 0.010 gr/dscf, then Cd emission should be equal to or less than 20 µg/dscm. Second, (implied), since the newer generation of existing facilities often reduce PM emissions to below 0.010 gr/dscf, then an achievable fair Cd emission limit would be 20 µg/dscm. WESI disagrees with these statements or hypotheses, and offers the following data analysis as evidence.

(i) WESI Facility Data

The Agency does not appear to have scrutinized closely enough the relationship between PM emissions and Cd emissions. Figure 1 presents such a comparison between PM and Cd for the WESI facility at North Andover, Massachusetts.

A test of the linear relationship between PM and Cd yields an R^2 value of 0.66. Roughly speaking, the variance in PM emissions explains about two-thirds of the variance in Cd emissions. The correlation coefficient is fairly strong at 0.81.

It is instructive, however, to note that EPA has set an emission guideline PM standard for plants above 1,100 tpd at 0.015 gr/dscf. North Andover has a 1,500 tpd capacity, and would be regulated as a very large facility where the 0.015 standard applies. Notwithstanding the 0.015 standard, EPA's consultant report states the 0.010 PM level would generally result in Cd levels less than 20 μ g/dscm. This appears to be true at first blush. Yet there are three data points out of 11 that are close to or exceed 0.01 gr/dscf for PM. Two things are important in this context.

First, there does appear to be a cluster of data points below 0.005 gr (PM) and 20 μ g (Cd). However, many data points are at or very close to 20 μ g Cd. Secondly, there are not enough data points present to calibrate the

relationship between Cd and PM when PM ranges between 0.010 and 0.015 gr/dscf.

Next, we added similar PM and Cd data from the Millbury, Massachusetts plant. Figure 2 presents the data for both plants and their respective curves. What is instructive is the fact that even with Millbury's SDA, the cluster of PM below 0.005 gr/dscf and Cd around 20 μ g is found. The effects of a scrubber on Cd concentrations is not as important as the effects of the PM control device. Also, as the number of data points increase, the number of data elements outside the PM-Cd cluster increases.

Figure 3 combines the 32 data points from North Andover and Millbury into a single graph with an accompanying linear regression analysis. Unlike North Andover alone, with an R^2 value of 0.66, the two plant regression between PM and Cd drops to an R^2 value of 0.45. The powers of predictive explanation decline, and there are more data points present. Still, there are not enough data points to calibrate the relationship between Cd and PM that ranges from 0.010 - 0.015

gr. Thus, the EPA hypothesis cannot be confirmed.

Next, we added another six data points from the Saugus, Massachusetts facility. Saugus is an older system that utilizes a two-field ESP. It has a smaller Specific Collection Area (SCA) than the other plants, and so it adds data points to the PM range between 0.010 - 0.015 gr.

The R^2 value is 0.67, which indicates that two-thirds of the variance in Cd emission is explained by the variance in PM emissions. This replicates the North Andover regression results, however, now there are enough data points to calibrate the PM range between 0.010 - 0.015 gr. At a PM emission rate of 0.010 the Cd emission rate can be expected to be roughly 41 μg . At a PM rate of 0.015 the Cd rate can be expected to be roughly 61 μg .

The Agency has just spent three years developing standards for MWCs. As previously stated, the size class of very large existing facilities will be expected to meet this 0.015 PM limitation. The region of the graph below the regression line but above the 20 μg Cd line, between 0.005

- 0.015 PM is the Region of Compliance Concern. Statistically speaking, we can "normally" expect to fall within this region when the PM standard is set at 0.015 gr. Thus, if a Cd emission limit is set at 20 $\mu\text{g}/\text{dscm}$, then a de-facto PM standard is being set that is much lower than 0.015 gr (i.e., 0.005 grains). Indeed, it will not be uncommon to yield Cd test results in the 41 - 61 μg range.

(ii) WESI Facility Data and EPA Data Combined

Predictive capabilities improve when the EPA Cd and PM data are added to data from the three WESI plants. The sample size increases to 68 (see Figure 5). The R^2 value increases to 0.74. Roughly speaking, about three-quarters of the variation in the Cd emissions rate is explained by the variance in PM emissions. When the linear regression equation is applied the Cd range extends from 32 - 47 μg with a corresponding PM range of 0.010 - 0.015 gr, respectively. This narrows the band of probable Cd emission rates from the similar analysis performed with respect to the three WESI facilities. It is clear, however, that the data are well above the 20 μg level.

(iii) Discussion

EPA is only partially correct in identifying the low Cd, low PM cluster of data points. A flaw in relying on this cluster to develop a numerical emission limit is that it ignores the actual distribution of data, such as is shown in Figures 4 and 5. It serves no purpose to compartmentalize the data according to the cluster phenomenon when the PM compliance point is to be set at 0.015 gr/dscf. By ignoring the strong statistical relationship between Cd and PM, the Agency may incorrectly choose a Cd standard (at 20 μ g) that would simultaneously establish a de-facto PM standard well below 0.010 gr. Indeed, the de-facto PM standard may be 0.005 gr, and this is a level that is simply unproven as a constantly achievable level of performance.

The data also suggest that you cannot guarantee Cd emissions lower than 20 μ g by simply adding a field to your ESP and setting the PM emission limit at 0.010 gr. While PM and Cd emission rates are statistically correlated, the correlation is not perfect. It will be statistically correct to assume PM test results

will exceed 0.010 sometimes, even after upgrading an ESP.

Theoretically assuming that PM and Cd emission rates are independent, a review of descriptive statistics suggest that ESP and SDA/ESP systems often exceed the 20 μg threshold. Table 1 presents summary statistics for the three WESI facilities. Based on 38 data points the resulting mean value is 25.4 μg ; and the upper 95% confidence interval is 76.5 μg . Combining the EPA data to the WESI data, with a combined total of 68 data points, the mean value increases to 28.5 μg ; and the upper 95% confidence interval is 84.3 μg . These summary statistics, based on more than doubling the sample size of the data base, offer strong evidence that a 20 $\mu\text{g}/\text{dscm}$ emission limit for SDA/ESP systems is not constantly achievable.

Finally, the issue raises the question of what Cd emission limit is appropriate for large, existing facilities (i.e., between 250 and 1,100 tpd)? After EPA has spent three years studying the issue, and has promulgated a PM standard of 0.03 gr/dscf , will a 20 μg Cd standard change the PM standard?

B. Existing Facilities with Fabric Filters

The EPA consultant report states that existing facilities using fabric filters (FFs) for PM control exhibit a linear relationship between PM and Cd emission rates. The report further states that fabric filters provide better PM control than ESPs; and that a low PM, low Cd cluster has been observed. The report then hypothesizes that a PM emission rate below 0.010 gr yields a simultaneous Cd emission rate below 10 µg/dscm. Again the hypothesis implies that FF systems are capable of meeting a 10 µg Cd emission limit. We scrutinized WESI and EPA data supporting this hypothesis.

(i) WESI Facility Data

Emissions test results for the Bridgeport, Connecticut facility are presented in Figure 6. A 2,250 tpd plant using SDA/FF for air pollution control, the Bridgeport facility is recognized as among the very best performing facilities in the world. Test results for nine test runs where PM and Cd were simultaneously measured yielded all non-detects for Cd emission. Indeed, the FF system is truly effective in metals control. The corresponding PM emissions

exhibit at least one measurement approximating the 0.015 gr level.

An additional nine test run results were obtained for the Gloucester, New Jersey facility. This facility is an 800 tpd facility using an SDA/FF air pollution control system. All nine Cd measurements were non-detect.

(ii) WESI Facility Data and EPA Data

The EPA consultant report makes gross assumptions about the linear relationship between PM and Cd emission rates in FF systems. We do not challenge the statement that such a linear relationship exists, mainly because we established that it does in systems using ESPs for PM control. However, the data base presented by EPA's consultant is not robust when gross assumptions are scrutinized.

For example, the report presents data for four SDI/FF systems, and 11 sets of test run results for SDA/FF systems. If you eliminate all test runs where simultaneous measurement of PM and Cd emissions were not actually performed, the sample size drops from 39 to 16. There is no

valid reason to accept imputed, non-simultaneous test results or otherwise calculated PM measurements as truly indicative of system performance.

When the actual 16 cases of simultaneous PM and Cd measurement are further examined the following observations come to light. The SDI/FF systems offer four test runs for Vancouver and Wurzburg that exhibit under 0.005 gr for PM with a corresponding Cd range of 3.7 - 5.5 μg . The remaining 12 cases offering simultaneous PM and Cd measurement exhibit a non-detect for Cd. Only three detects are found in the Long Beach test runs; and while the PM values averaged roughly 0.006 gr, the corresponding Cd values averaged 18 μg . This result is contradictory of the original hypothesis that Cd emissions should be less than 10 μg when PM is less than 0.01 gr.

(iii) Discussion

The critical question is -- can MWCs using a FF system to control PM meet a Cd emission limit of 10 $\mu\text{g}/\text{dscm}$? The short answer to this question is -- the EPA has not presented data to confirm

that FF systems are capable of constantly achieving a 10 $\mu\text{g}/\text{dscm}$ limitation for Cd. Further, WESI data cannot confirm this hypothesis with data we have analyzed. There is no technically defensible evidence to support either the low PM, low Cd cluster phenomenon, or the suggested linear relationship between the two variables in facilities using FF control systems.

The WESI data were comprised of non-detects for Cd. However, one non-detect among the Bridgeport test campaign was very close to a 10 μg emission rate. EPA should carefully consider and explain what effects error bands may play when a detection limit is so perilously close to a compliance limit.

The EPA consultant report attempts to grossly force-fit the supposed linear relationship between PM and Cd by replacing "not measured" PM data elements with separate PM test data. This is unacceptable. Nothing less than simultaneous PM/Cd measurements should be allowed when: (1) data are sparse such as is the case here; (2) when sparse data are used to support a hypothesis concerning the statistical

relationship between two variables; and (3) when a very loosely supported hypothesis is relied upon to set a numerical emission limit which serves as a compliance condition subject to violation and fine.

A hard look at EPA data, removing all non-simultaneous PM/Cd measurements and all non-detects of these data points refute the hypothesis that low PM rates result in less than 10 $\mu\text{g}/\text{dscm}$ of Cd. One data point is so close to the 10 μg level (9.5 μg) that it could be counted either way. The four data points that appear to cluster at low PM, low Cd involve DSI/FF systems (Wurzburg and Vancouver). Basing a linear hypothesis and possibly an emission limitation on four data points is not advisable.

II. LEAD EMISSION STANDARDS AND CONTROL TECHNOLOGY FOR NEW AND EXISTING MWCS

A. Existing Facilities with ESPs and SDA/ESPs

The EPA consultant report states that mass burn facilities may have uncontrolled lead (Pb) emission rates that range around 32,000 $\mu\text{g}/\text{dscm}$, based on inlet

data. The report further states the hypothesis that recently built SDA/ESP systems experience Pb emissions generally below 300 $\mu\text{g}/\text{dscm}$ when PM emissions are roughly 0.010 gr/dscf . The implication is that retrofitting ESP only facilities with an SDA/ESP configuration will yield a capability of achieving less than 300 $\mu\text{g}/\text{dscm}$ of Pb.

(i) WESI Facility Data

The relationship between Pb and PM emission rates was compared for the Millbury facility (see Figure 7). Twenty-one data points representing simultaneous Pb/PM measurements exhibit a low PM, low Pb cluster. However, one data point exceeded 600 $\mu\text{g}/\text{dscm}$ Pb and roughly 0.019 gr/dscf PM. Once again, similar to the Cd/PM situation, a quick glance easily leads the observer to compartmentalize the data and ignore the data distribution. While the R^2 value of 0.71 is moderately strong, there are not enough data points between the 0.010 - 0.015 gr/dscf PM to calibrate the linear relationship with statistical accuracy. It is not clear whether or not the SDA has any influence on Pb emissions.

Unlike Millbury which uses a SDA/ESP system, the North Andover plant uses ESP only. When Pb/PM data from North Andover are graphed with similar data for Millbury, the additional 11 data points expand the Cd range over 300 µg/dscf. When these data points are combined to perform a linear regression the resultant R^2 value is 0.40 (see Figure 9). Using the predictive linear equation to calibrate expected Pb levels given a 0.010 - 0.015 gr PM range, the respective Pb levels are 358 - 472 µg/dscm. It is clear that a PM compliance level of 0.015 should not be expected to constantly yield Pb emissions below 300 µg.

By adding another six data points from Saugus test results the R^2 value increases to 0.52 (Figure 10). The predictive equation yields Pb rates of 944 - 1,447 µg in the respective 0.010 - 0.015 gr PM range.

(ii) WESI Facility Data and EPA Data Combined

When the EPA data are combined with the WESI data the number of data points increases from 38 to 68. The explanatory power of the increased data base, using a linear regression, also

increases. The R^2 value is 0.71, and the correlation coefficient is 0.84 (Figure 11). The statistical association is fairly strong. Using the predictive linear equation, Pb ranges from 811 - 1,231 μg when PM ranges from 0.010 - 0.015 gr, respectively. Note that inclusion of EPA data depended on actual simultaneous measurement of Pb and PM emissions.

Descriptive statistics for the combined WESI/EPA data are presented in Table 4. While Figure 11 suggests Pb ranges between 811 - 1,231 μg in the critical PM range, Table 4 suggests that the 95% confidence interval for Pb, based on these 68 test measurements, ranges to as high as 2,374.3 $\mu\text{g}/\text{dscm}$. Theoretically speaking, if uncontrolled inlet emissions are roughly 32,000 μg , then the upper 95% confidence interval outlet emission rate exceeds 92% removal efficiency.

(iii) Discussion

Similar to the Cd/PM situation discussed earlier with regard to ESP or SDA/ESP systems, the Pb/PM data for WESI facilities and for WESI facilities combined with EPA data substantiate a linear

relationship. While a cluster of low Pb, low PM data does exist there is no reason to ascribe this portion of the data distribution to be a function of SDA/ESP systems. Statistically speaking, it is just as reasonable to assert that there is a cluster (albeit with greater variance) of data points well in excess of 300 μg Pb and 0.010 PM. We reject the hypothesis for ESP and SDA/ESP systems that Pb is less than 300 μg when PM is less than 0.010 gr as a distorted interpretation of the sample data. We conclude that a PM standard of 0.015 gr serves as good particulate control, and simultaneously, good control of Pb (and Cd, and other metals). We conditionally conclude that at a 0.015 gr PM standard, Pb will range up in excess of 1,200 μg . A 300 μg Pb standard has not been demonstrated as constantly achievable.

B. Existing Facilities with Fabric Filters

EPA's consultant report states that recently built SDA/FF systems provide greater control of fine PM than ESPs; and PM emission rates of roughly 0.010 gr usually yield corresponding Pb emission rates of 100 μg or less. The report also states that Pb and PM have a

linear relationship, but that the high performance of FF systems tend to result in a low Pb, low PM cluster.

(i) WESTI Facility Data

Combined simultaneous Pb-PM data are presented in Figure 12 representing test results from Bridgeport, Gloucester and the Concord, New Hampshire facilities. All of these facilities use FF control systems. While only 14 data points appear on the graph it should be pointed out that the graph only includes test results for Pb that were above detection limits.

These data suggests a linear relationship between Pb and PM emission rates. The R^2 value is 0.81 (fairly strong); and a correlation coefficient of 0.9 (very strong association). We observe the low Pb, low PM cluster phenomenon, but do not have enough data to calibrate the relationship between Pb emission rates when PM ranges between 0.010 - 0.015 gr.

It is important to note that there are two data points that exceed the 100 μ g Pb level and the 0.010 gr PM level at the same time. Since 14 data points are not robust enough to confirm the

EPA hypothesis (if PM < 0.010 gr, then Pb < 100 µg), it would be appropriate to add to the data base. However, because of the high Pb-PM occurrences, the Agency should not rely totally on a compartmentalized view of the data distribution.

(ii) WESI Facility Data and EPA Data Combined

EPA data were added to the WESI data where simultaneous measurement of Pb-PM were available (Table 5). The data points increased from 14 to 31. The R^2 value decreased by adding the EPA data to $R^2 = 0.54$; the correlation coefficient decreased to 0.73. The explanatory power of the combined data suggests that Pb emission rates range between 53.6 - 80 µg when PM rates range from 0.010 - 0.025 gr, respectively.

Most of the additional 17 data points add to the low Pb, low PM cluster. However, the Vancouver results cluster around 78 µg Pb and 0.005 gr PM. These relatively high Pb emission rates suggest that as the data base increases, the probability of wider variance in measured Pb emission rates will increase. Adding the few Vancouver and WESI Pb emission rates that do not belong to the

cluster casts some doubt on whether the EPA hypothesis will holdup when the true data distribution is accounted for.

(iii) Discussion

Facilities utilizing FF control systems exhibit very good Pb-PM control. Available data are primarily comprised of non-detects for Pb. A low Pb-PM emission rate cluster is identifiable. However, there are five (of 31) data points that extend well beyond the cluster with regard to either/or Pb-PM measurements. It is not clear if these measurements are aberrations or part of the normal population of Pb-PM measurements. EPA should focus on obtaining more Pb-PM data to determine the true distribution of the sample population. EPA should also collect more data in an attempt to calibrate the Pb emission rate when PM ranges between 0.010 - 0.015 gr.

III. MERCURY EMISSION STANDARDS AND CONTROL TECHNOLOGY FOR MWCS

WESI has previously submitted comments to the Agency under the parent company name Wheelabrator Technologies, Inc., and in conjunction with the Institute of Resource Recovery.

In those comments we emphasized that the efficacy of flue gas additives in European and Canadian facilities was questionable given the near total lack of information on quality assurance in the test campaigns, and the lack of comparative control information on facility operating envelopes. We also emphasized that the test method may have flaws; and we recognize that the lack of consistent test method application in different laboratories may distort mercury (Hg) concentration measurements.

The EPA consultant report accompanying the NAPCTAC meeting package presents text and data describing Hg and dioxin/furan emission rates stratified by combustor type and air pollution control device configuration. This information, however, does not offer any insight into the efficacy of flue gas additives on these systems. It is our understanding that the Agency is currently planning to conduct or participate in experimental test campaigns. We urge the Agency to include testing of SDA/ESP systems.

The Hg emission issue has often been placed in a cross-cultural context. The Agency has often referred to outstanding achievement in Hg control in Europe. One important factor that is often overlooked is the significant difference in Hg content in the European waste stream compared to the U.S. waste stream. In setting a

numeric emission limit or percent removal efficiency it is important to account for such Hg loading differences.

We compared Hg inlet data available for four European facilities (57 samples), and five U.S. facilities (60 samples), (see Table 6). The average Hg inlet rate for the U.S. is slightly more than twice the average for European facilities. A difference of means test using a two-tail student's t technique indicates that the U.S. and European Hg loadings are significantly different at the 0.0001 probability level.

Since the Hg load in U.S. waste is statistically significantly higher than the Hg load in European waste, the Agency should carefully consider what control technology should be applied, and at what level such controls should be expected to achieve on a continual basis.

TABLE 1

Statistical Information for Combined WES PlantsMillbury, North Andover, & Saugus
Cadmium & Particulate Data

DESCRIPTIVE STATISTICS

All plants:

	<u>Particulate</u> Gr/dscf @ 7% O ₂	<u>Cadmium</u> ug/dscm @ 7% O ₂
Size	38	38
Mean	0.00592	25.47787
Standard Deviation	0.00531	25.52153
Standard Error	0.00086	4.14014
Minimum	0.0004	4.456
Maximum	0.0201	100.38
Range	0.0197	95.924
Confidence Interval	0.01654	76.52093

TABLE 2

Statistical Information for Figure 5

Millbury, North Andover, Saugus,
Quebec, Portland, Dayton, and Pinellas
Cadmium and Particulate Data

DESCRIPTIVE STATISTICS

	<u>Particulate</u> Gr/dscf @ 7% O ₂	<u>Cadmium</u> ug/dscm @ 7% O ₂
Size	68	68
Mean	0.00861	28.5051
Standard Deviation	0.00846	27.92791
Standard Error	0.00103	3.38676
Minimum	0.00042	2.02
Maximum	0.0327	100.38
Range	0.0323	98.3
Confidence Interval	0.02553	84.36095

TABLE 3

Consolidated EPA Data for PM and Cd
in Systems with Fabric Filters

<u>Facility</u>	<u>Pollution Control</u>	<u>Average gr/dscf</u>	<u>Average μg/dscm</u>	<u>No. of Runs</u>
		PM	Cd	
Vancouver	DSI/FF	0.004	3.7	3
Quebec	DSI/FF	NM	ND	3
St. Croix	DSI/FF	NM	2 ^a	3
Wurzburg	DSI/FF	0.004 ^b	5.5 ^a	1
Babylon	SDA/FF	0.001	ND	3
Commerce	SDA/FF	NM	1-9	3
Commerce	SDA/FF	NM	0.4	3 ^c
Long Beach	SDA/FF	0.006	18	3
Marion County	SDA/FF	NM	2.6	3
Quebec City	SDA/FF	NM	ND	3 ^c
Quebec City	SDA/FF	NM	ND	2
Stanislaus	SDA/FF	NM	1.72	2
Stanislaus	SDA/FF	NM	2.11	3
Hempstead	SDA/FF	0.001	ND	3
Hempstead	SDA/FF	0.002	ND	3

a One Cd measurement was non-detect.

b Not an average; based on a single test result.

c One measurement not counted in average.

SOURCE: Abstracted from White, D. and Nebel, K., September 1990

TABLE 4

Statistical Information for Figure 11

Millbury, North Andover, Saugus,
Quebec, Portland, Dayton, and Pinellas
Lead and Particulate Data

DESCRIPTIVE STATISTICS

	<u>Particulate</u> Gr/dscf @ 7% O ₂	<u>Lead</u> ug/dscm @ 7% O ₂
Size	68	68
Mean	0.00861	694.9777
Standard Deviation	0.00846	839.6826
Standard Error	0.00103	101.8265
Minimum	0.00042	7.288
Maximum	0.0327	3202
Range	0.0323	3194.712
Confidence Interval	0.02553	2374.343

TABLE 5

Consolidated EPA Data for PM and Pb in
Systems with Fabric Filters

<u>Facility</u>	<u>Pollution Control</u>	<u>Average gr/dscf</u>	<u>Average µg/dscm</u>	<u>No. of Runs</u>
		PM	Pb	
Vancouver	DSI/FF	0.0044	78	3
Quebec	DSI/FF	NM	6.3	2
Quebec	DSI/FF	NM	6.31	3
Quebec	DSI/FF	NM	2.59	2
Quebec	DSI/FF	NM	3.94	1
Wurzburg	DSI/FF	0.044	11	1
Babylon	SDA/FF	0.001	1.43	3
Indianapolis	SDA/FF	NM	4.26	3
Commerce	SDA/FF	NM	1.9	3
Commerce	SDA/FF	NM	2.9	3
Long Beach	SDA/FF	0.0047 ^a	13.9	1 ^b
Marion County	SDA/FF	NM	19	2
Quebec	SDA/FF	NM	2.4	1 ^c
Quebec	SDA/FF	NM	6.1	2
Stanislaus	SDA/FF	NM	22.77	3
Stanislaus	SDA/FF	NM	36.8	3
Hempstead	SDA/FF	0.0012	1.58	3
Hempstead	SDA/FF	0.0027	4.05	3
Hempstead	SDA/FF	0.0015	6.38	3

a Not an average, based on a single test result

b 3 test runs, 2 non-detects

c 2 test runs, 1 non-detect

SOURCE: Abstracted from White, D. and Nebel, K., September 1990

TABLE 6

Comparison of Mercury Inlet Emission Rates for
European and U.S. Facilities

Descriptive Statistic	European ^a ($\mu\text{g}/\text{dscm}$ @ 7% O_2)	U.S. ^b
Mean	454.6	934.2
Standard Deviation	303.9	381.9
Upper 95% Confidence Interval	1,062.5	1,697.9
Number of Samples	57	60

a Includes data reported for Leverfusen, Kassel, Amager, Zurich

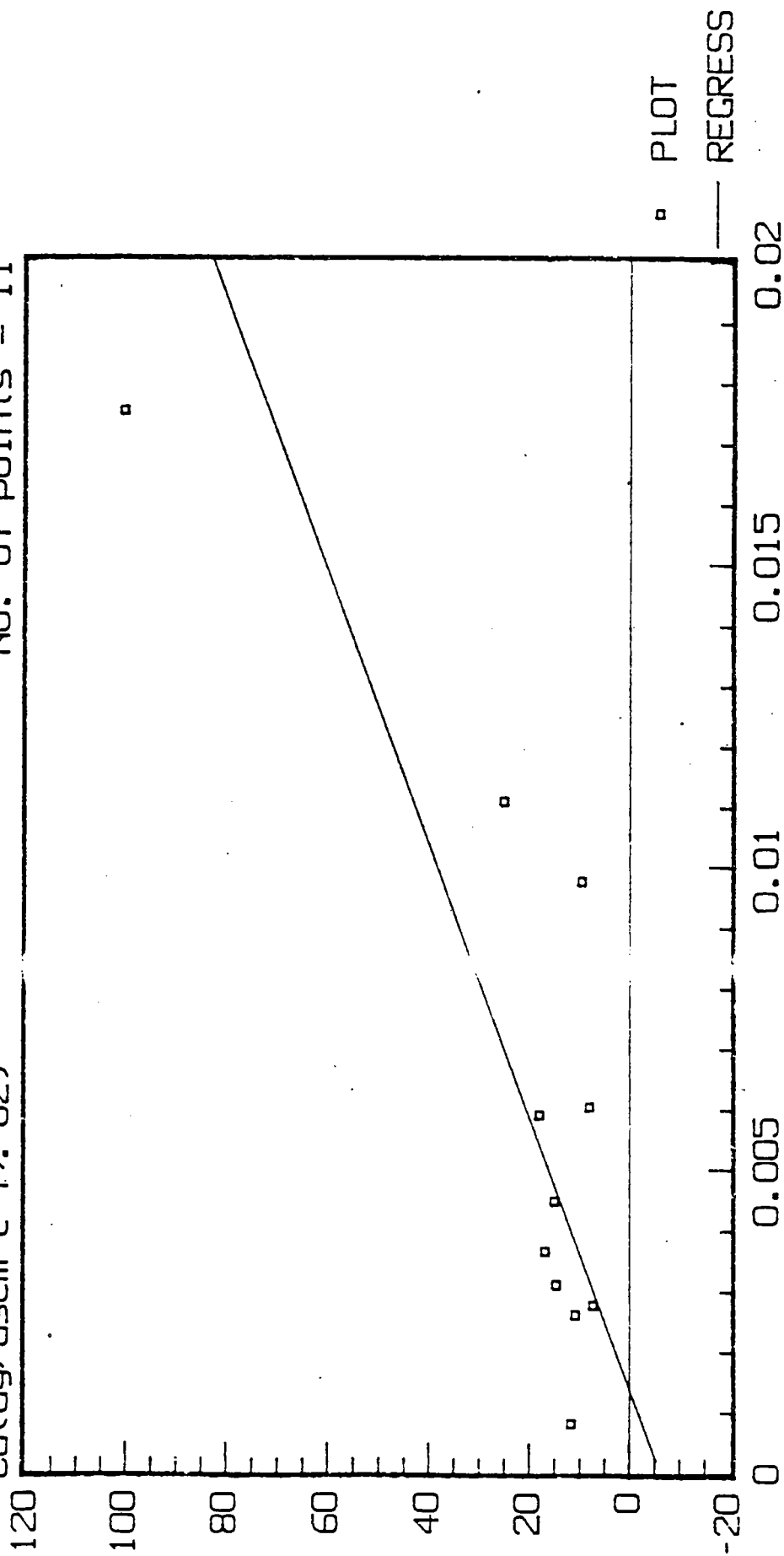
b Includes data reported for Burnaby, Bridgeport, Gloucester,
Indianapolis, Millbury

North Andover
Cadmium Data

R²: 0.66168 Corr.: 0.81319
Lin.: $Y = -6.00659 + 4446.296 * X$

Cd(ug/dscm @ 7% O₂)

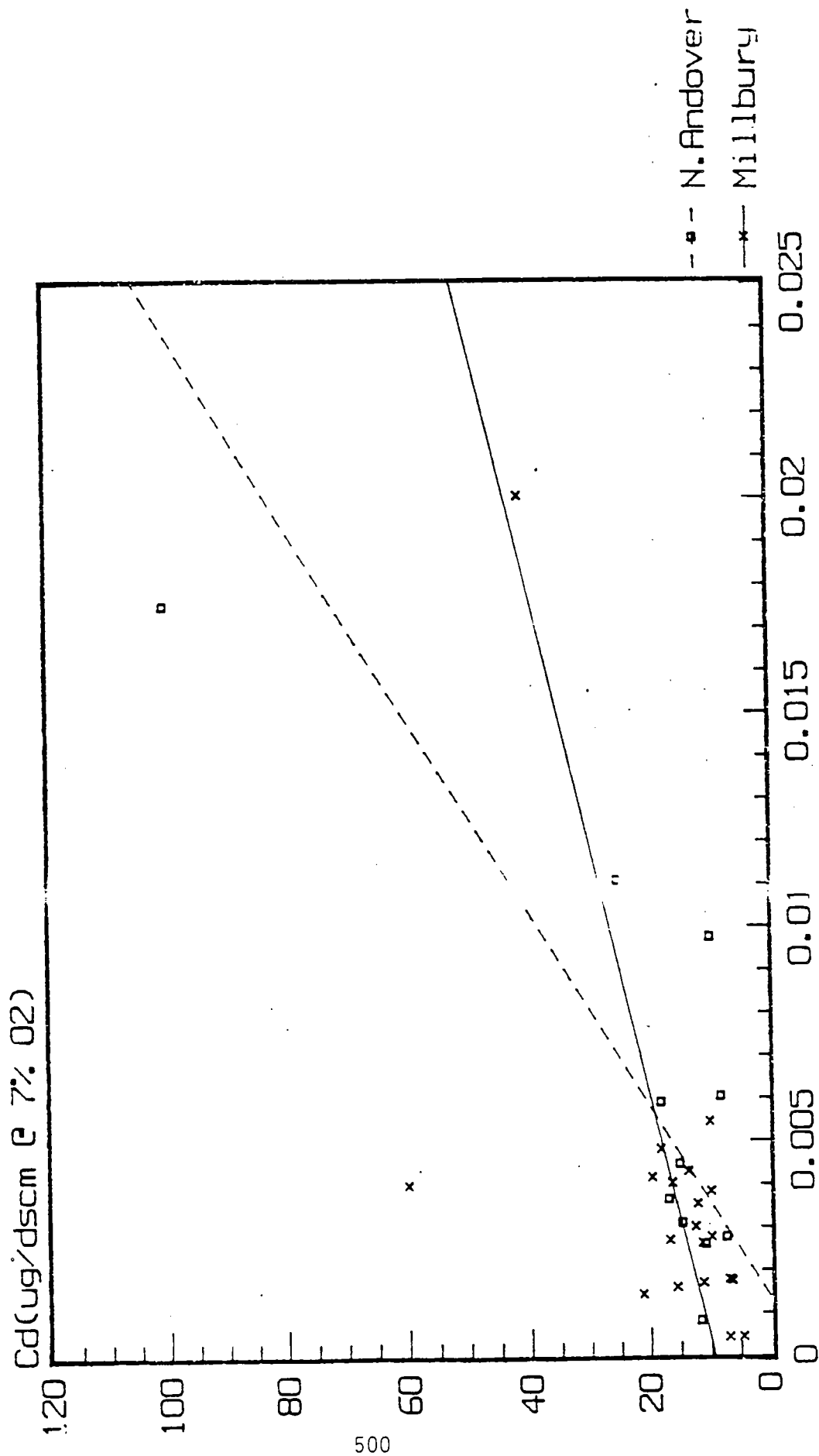
No. of points = 11



PM(Gr/dscf @ 7% O₂)

Figure: 1

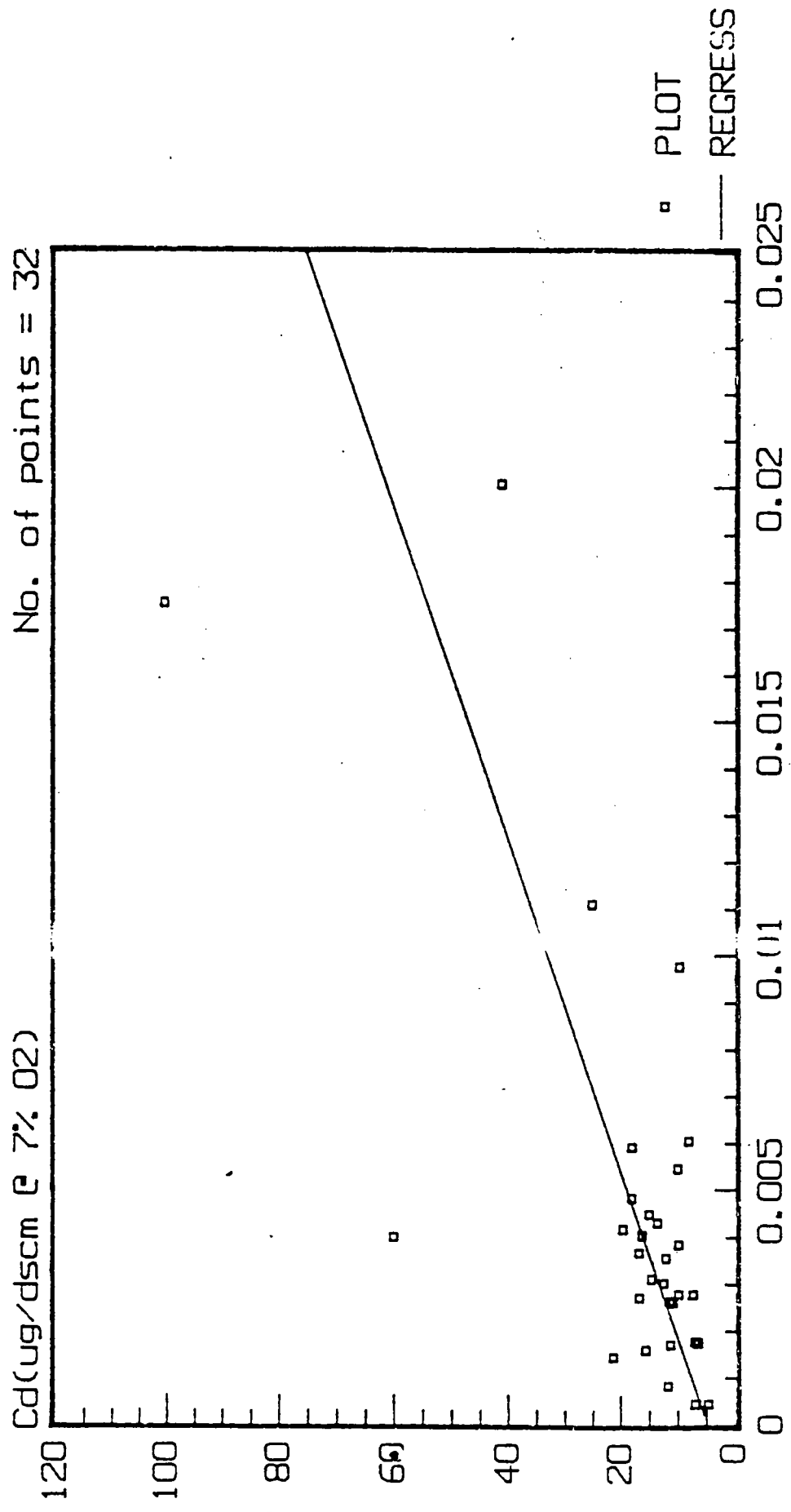
Millbury & North Andover Calcium Data



Millbury & North Andover
Combined Cadmium Data

$R^2: 0.45367$ $\text{Corr.: } 0.67367$
 $\text{Lin.: } Y = 4.88875 + 2820.445 * X$

No. of points = 32



PM(G1/dscf @ 7% O2)

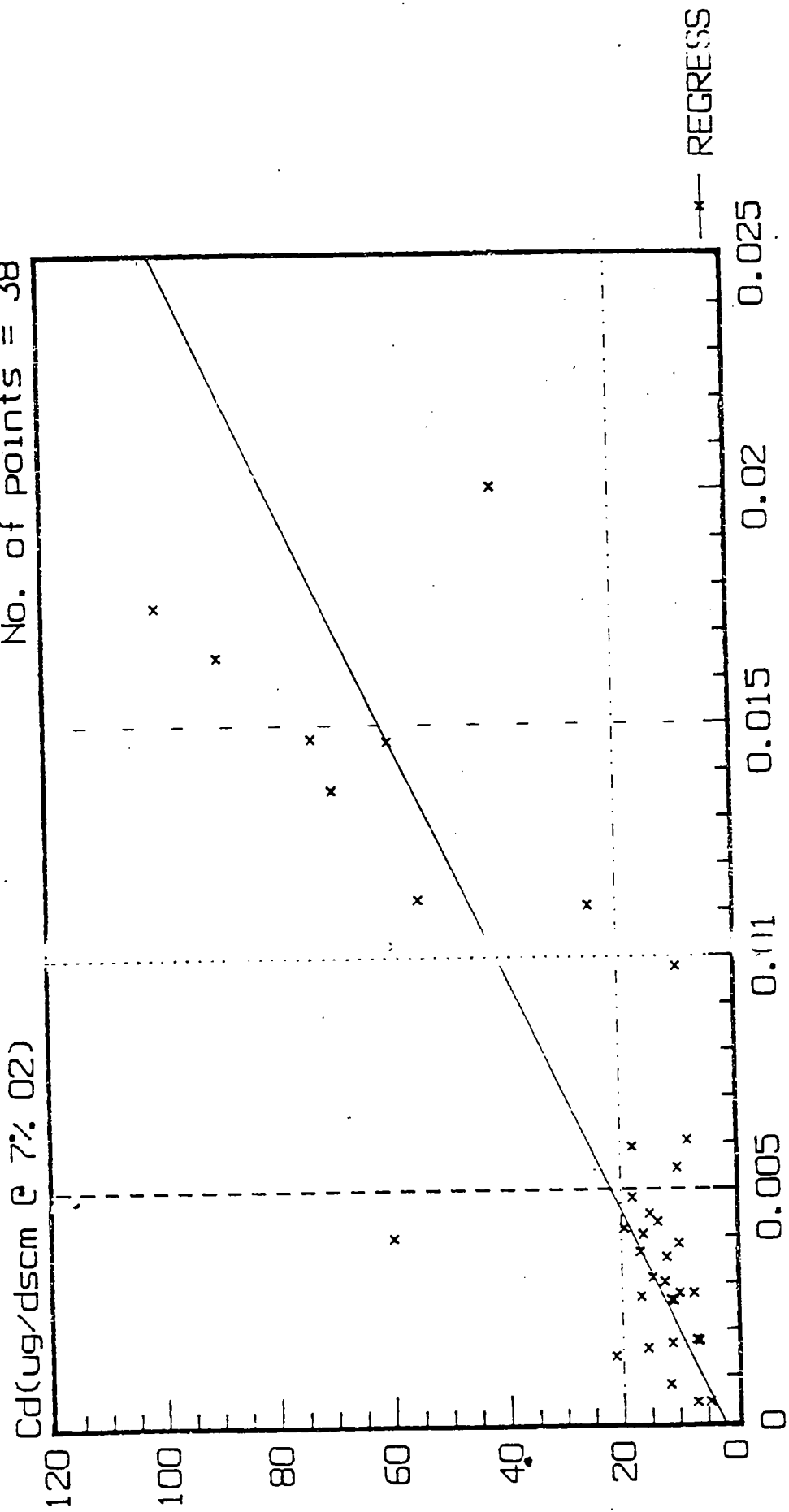
Figure: 3

Millbury, North Andover, & Saugus
Combined Cadmium Data

$R^2: 0.66998$ $\text{Corr.}: 0.81852$

$\text{Lin.}: Y = 2.18932 + 3934.318 * X$

No. of points = 38



MESI & EPA

Combined Cadmium Data

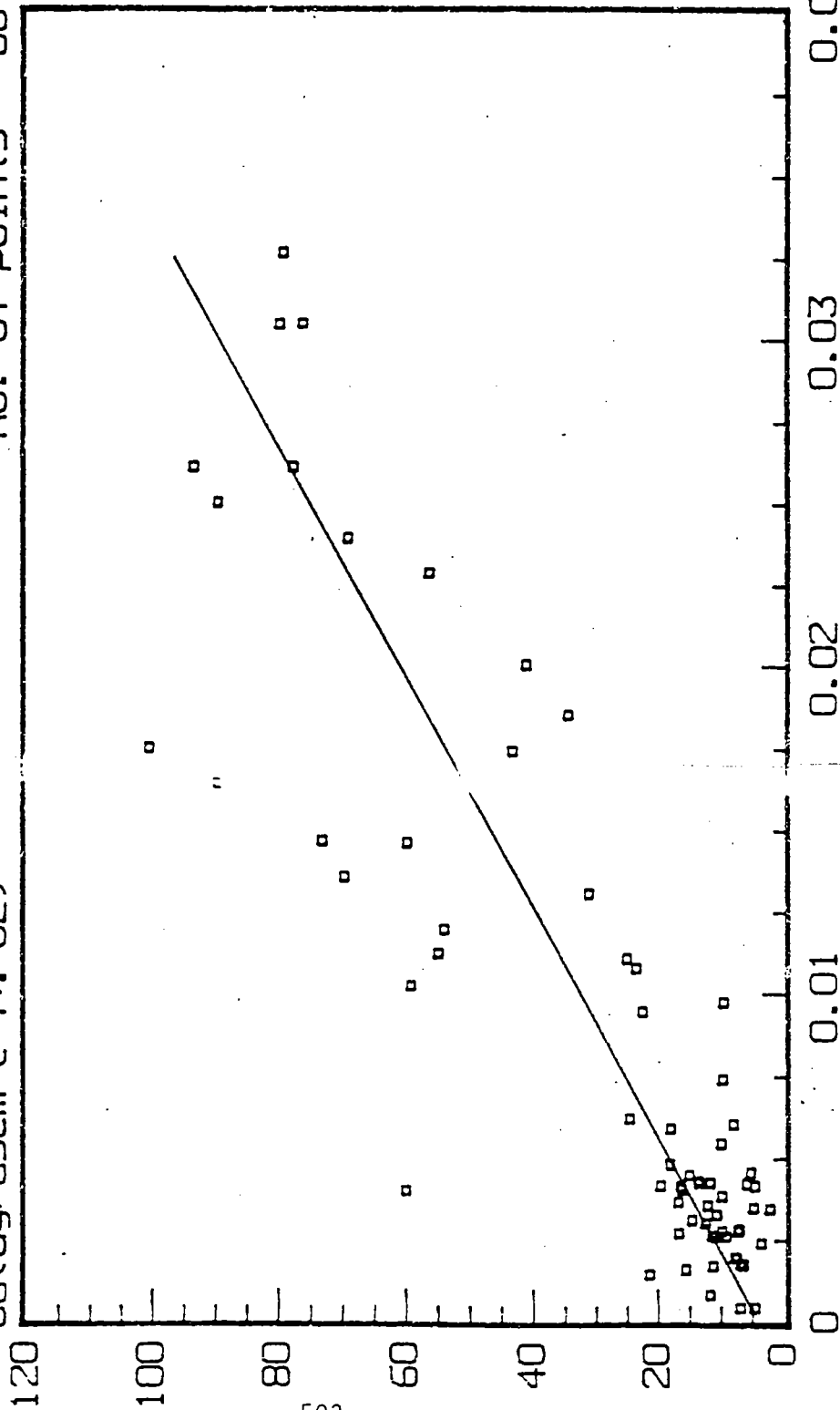
$R^2: 0.7431$

Corr.: 0.86203

Lin.: $Y = 4.00811 + 2845.211 * X$

Cd(ug/dscm @ 7% O2)

No. of points = 68



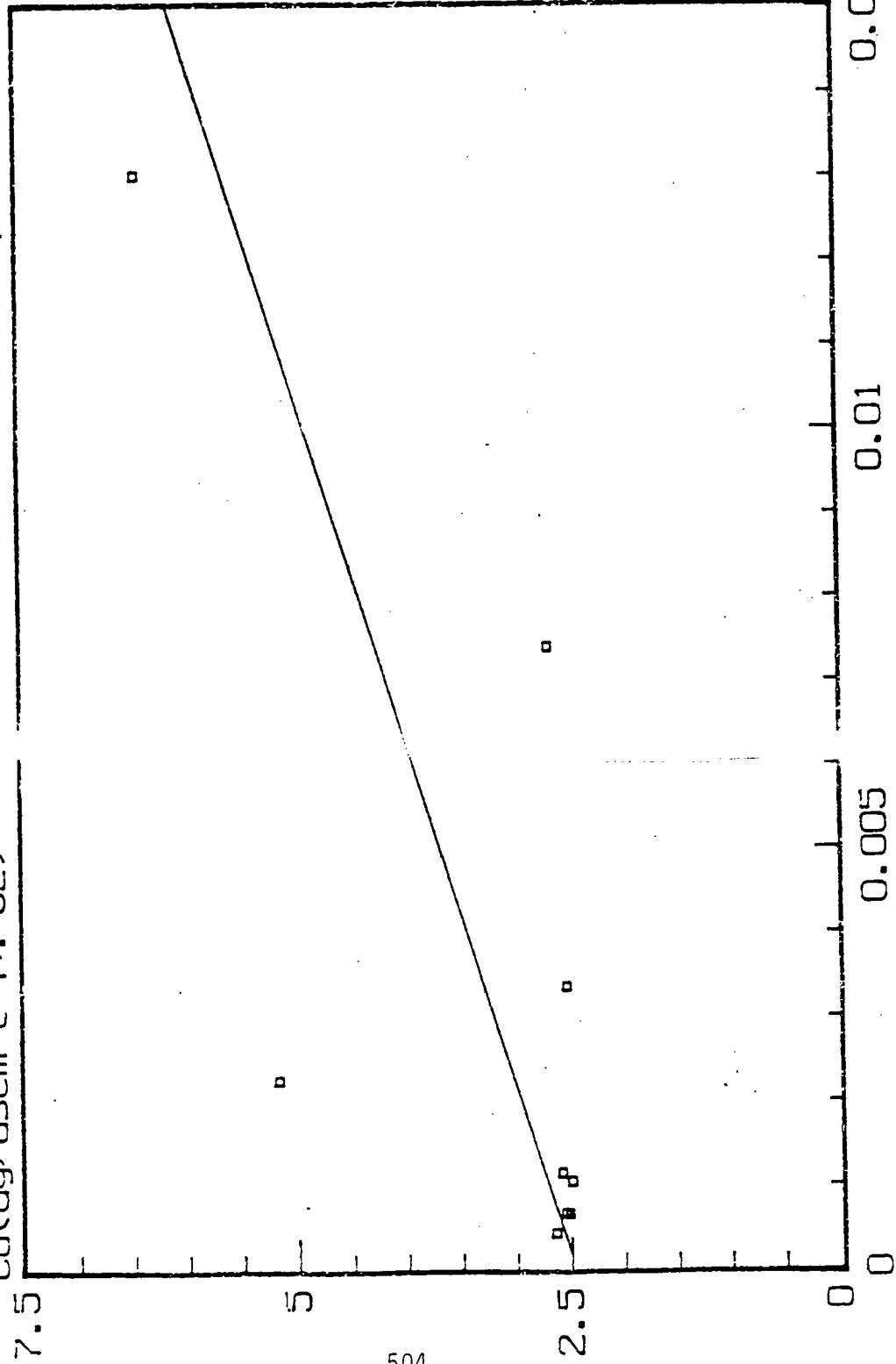
PM(G/dscm @ 7% O2)

Figure: 5

Widgeport
Cadmium Data (not detected)

No. of points = 9

Cd(ug/dscm @ 7% O2)



□ PLOT
— REGRESS

PM(G/dscm @ 7% O2)

Figure: 6

Millbury Lead Data

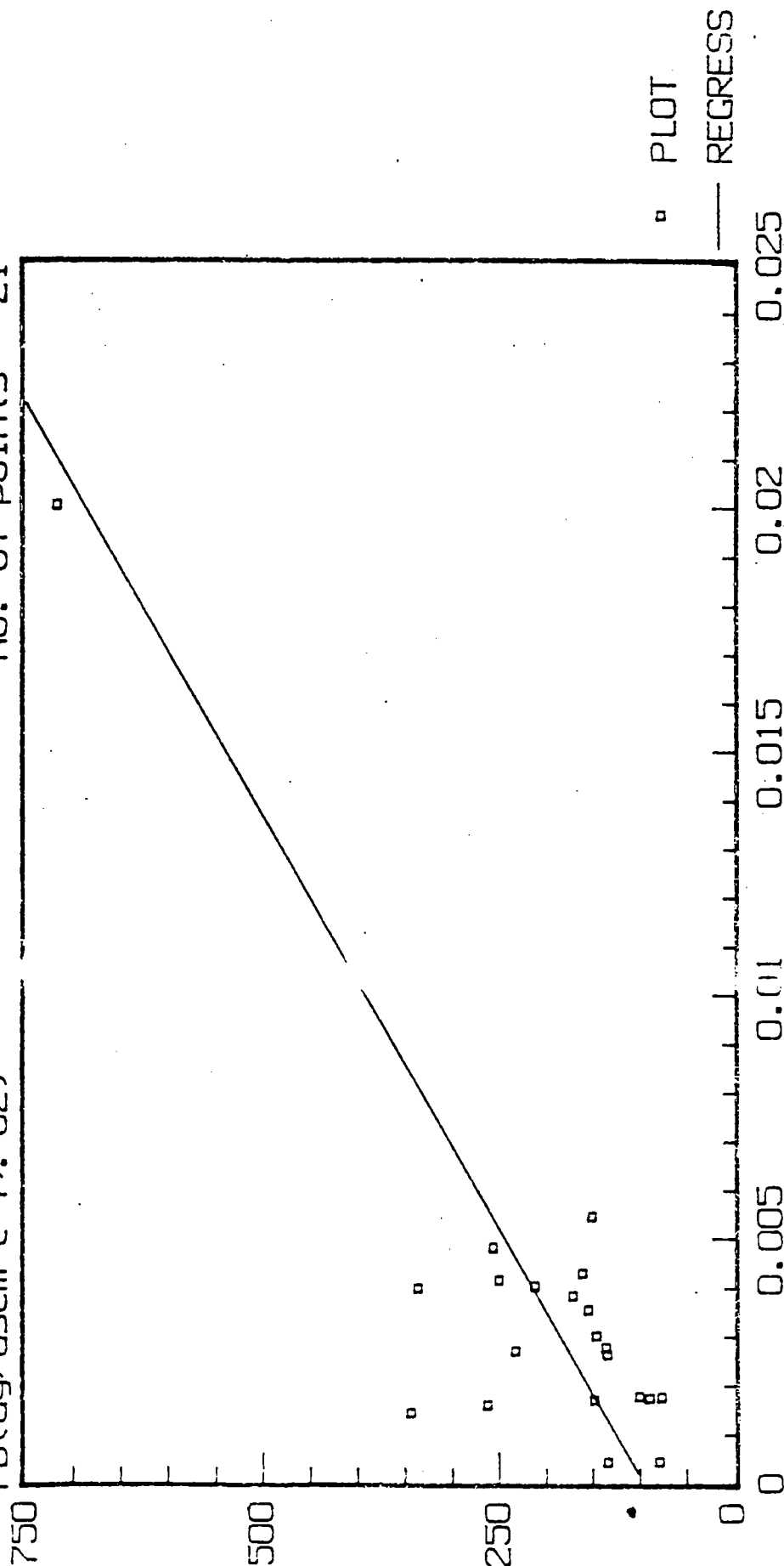
R²: 0.71301

Lin.: $Y = 96.32925 + 29497.54 \cdot X$

Corr.: 0.8444

Pb(ug/dscm @ 7% O₂)

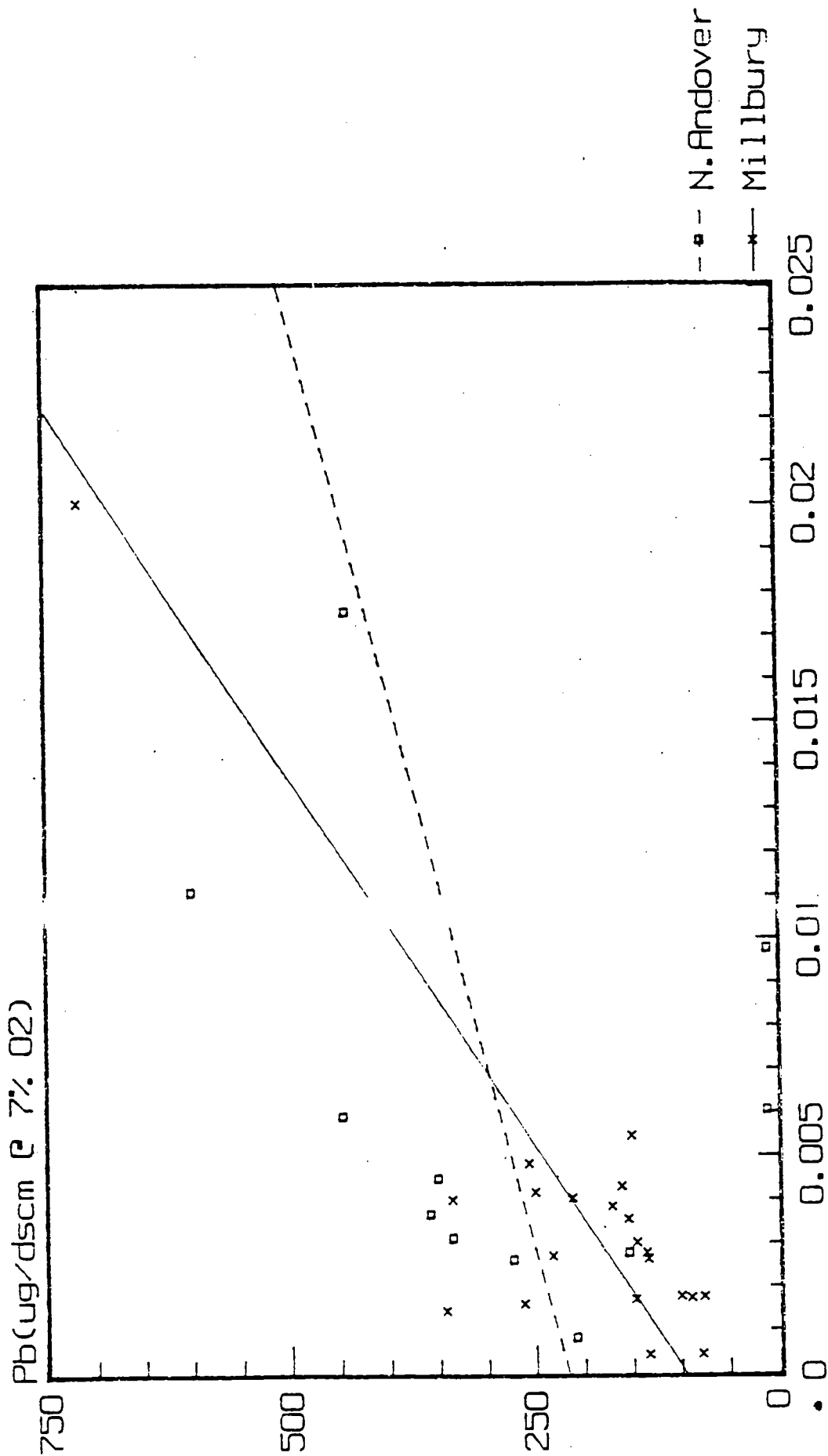
No. of points = 21



PM(Gr/dscf @ 7% O₂)

Figure: 7

Millbury & North Andover Lead Data



PM10(Gr dscf @ 7% O2)
Figure: 8

TABLE 5

Consolidated EPA Data for PM and Pb in
Systems with Fabric Filters

<u>Facility</u>	<u>Pollution Control</u>	<u>Average gr/dscf</u>	<u>Average µg/dscm</u>	<u>No. of Runs</u>
		PM	Pb	
Vancouver	DSI/FF	0.0044	78	3
Quebec	DSI/FF	NM	6.3	2
Quebec	DSI/FF	NM	6.31	3
Quebec	DSI/FF	NM	2.59	2
Quebec	DSI/FF	NM	3.94	1
Wurzburg	DSI/FF	0.044	11	1
Babylon	SDA/FF	0.001	1.43	3
Indianapolis	SDA/FF	NM	4.26	3
Commerce	SDA/FF	NM	1.9	3
Commerce	SDA/FF	NM	2.9	3
Long Beach	SDA/FF	0.0047 ^a	13.9	1 ^b
Marion County	SDA/FF	NM	19	2
Quebec	SDA/FF	NM	2.4	1 ^c
Quebec	SDA/FF	NM	6.1	2
Stanislaus	SDA/FF	NM	22.77	3
Stanislaus	SDA/FF	NM	36.8	3
Hempstead	SDA/FF	0.0012	1.58	3
Hempstead	SDA/FF	0.0027	4.05	3
Hempstead	SDA/FF	0.0015	6.38	3

a Not an average, based on a single test result

b 3 test runs, 2 non-detects

c 2 test runs, 1 non-detect

SOURCE: Abstracted from White, D. and Nebel, K., September 1990

TABLE 6

Comparison of Mercury Inlet Emission Rates for
European and U.S. Facilities

Descriptive Statistic	European ^a ($\mu\text{g}/\text{dscm}$ @ 7% O_2)	U.S. ^b
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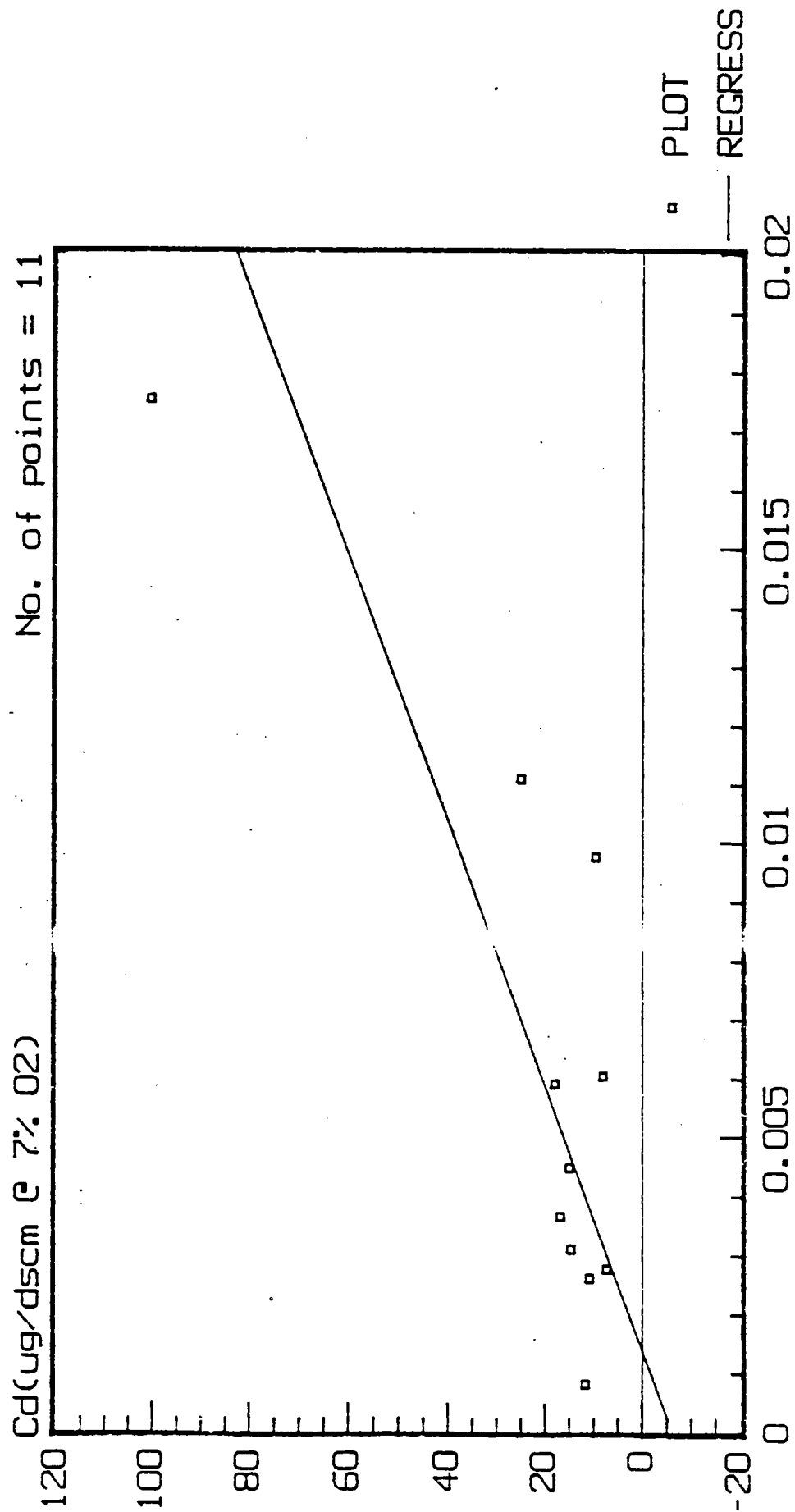
a Includes data reported for Leverfusen, Kassel, Amager, Zurich

b Includes data reported for Burnaby, Bridgeport, Gloucester,
Indianapolis, Millbury

North Andover
Cadmium Data

$R^2: 0.66168$ $\text{Corr.}: 0.81319$
 $\text{Lin.}: Y = -6.00659 + 4446.296 * X$

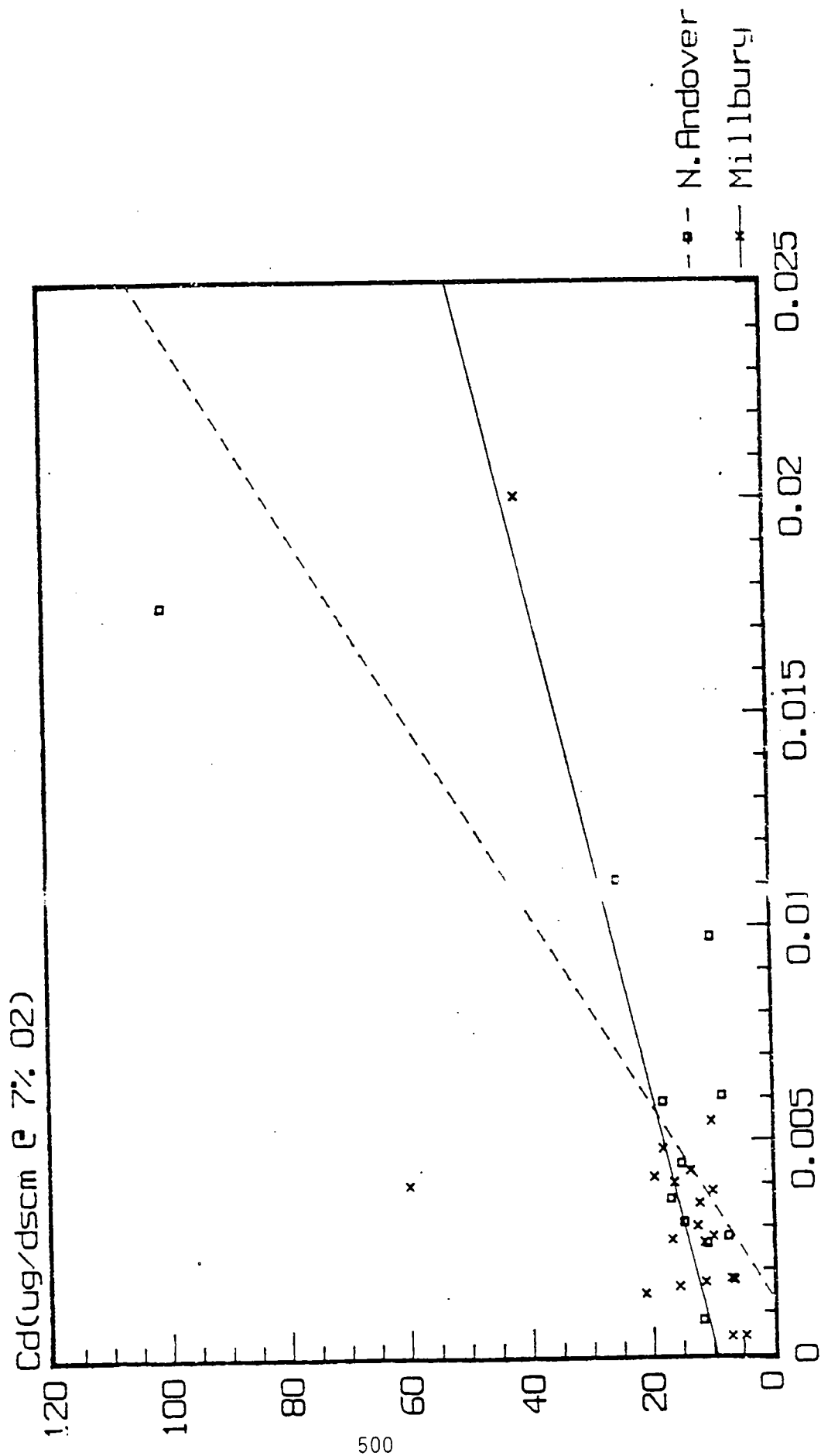
No. of points = 11



PM(Gr/dscf @ 7% O2)

Figure: 1

Millbury & North Andover Cadmium Data



PM(G/dscm @ 7% O_2)
Figure: 2

Millbury & North Andover

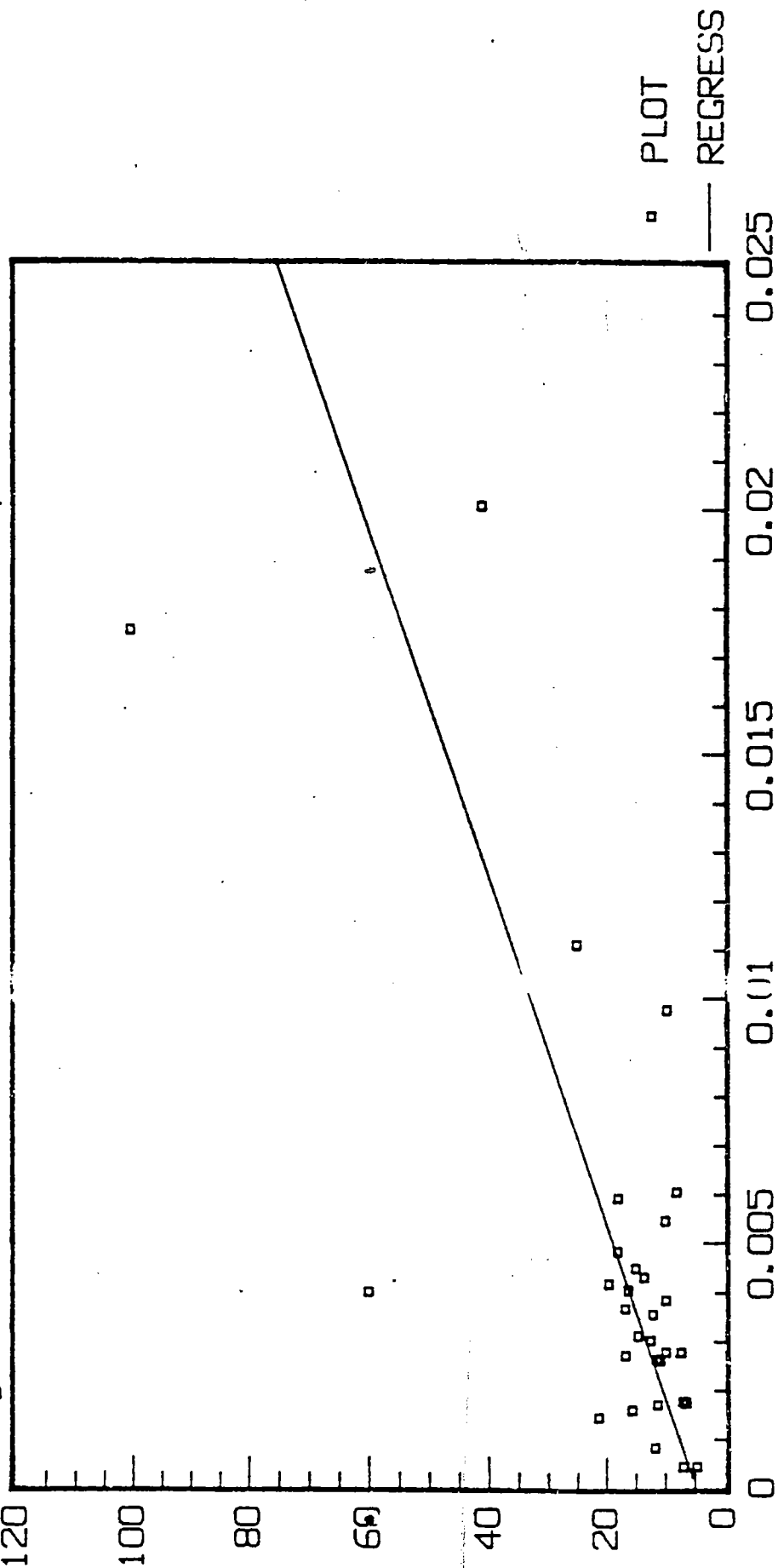
Combined Cadmium Data

$R^2: 0.45367$ $\text{Corr.}: 0.67367$

$\text{Lin.}: Y = 4.88875 + 2820.445 * X$

Cd(ug/dscm @ 7% O2)

No. of points = 32



PM(G/dscf @ 7% O2)

Figure: 3

Millbury, North Andover, & Saugus

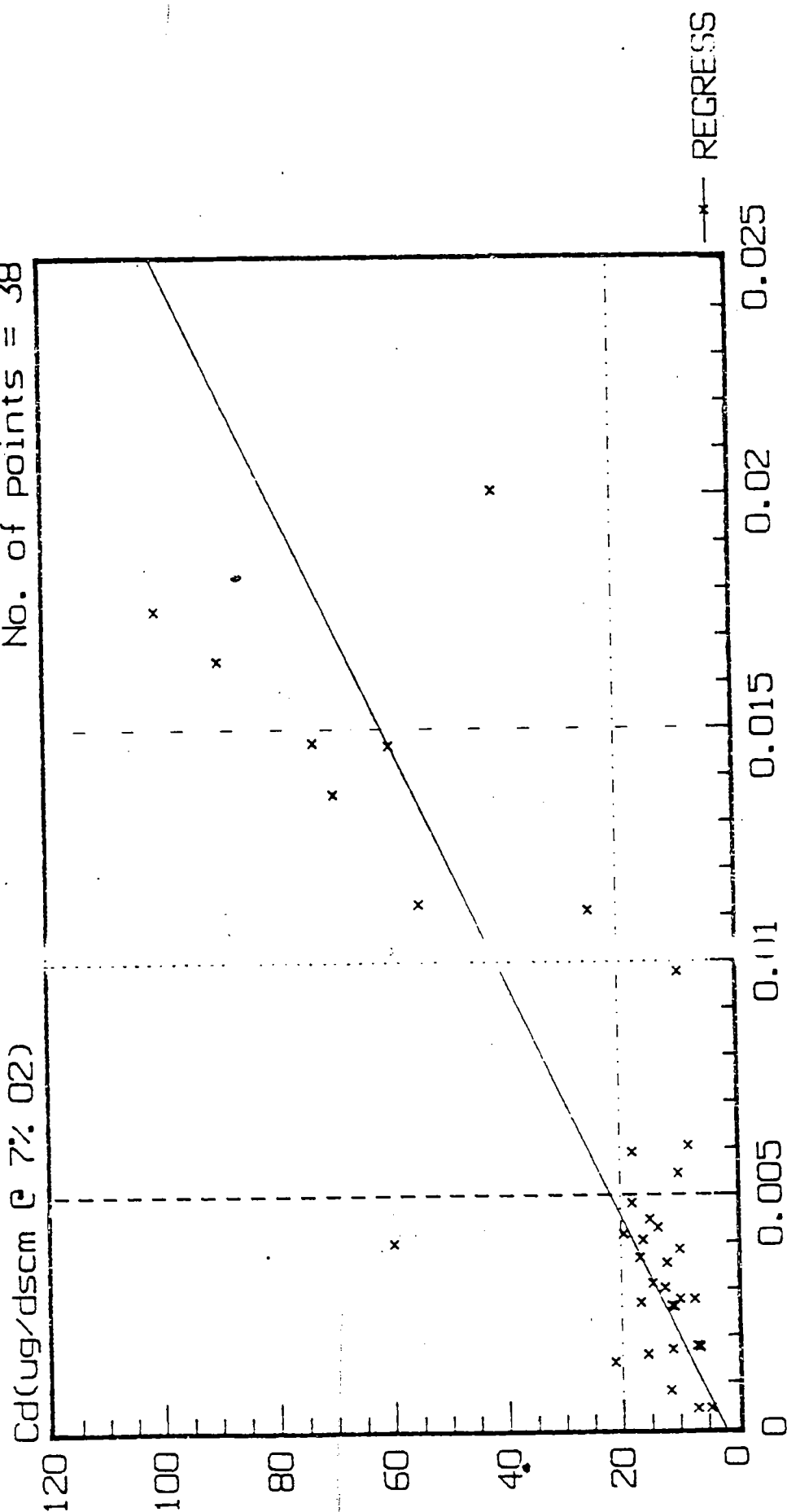
Combined Cadmium Data

$R^2: 0.66998$

Corr.: 0.81852

Lin.: $Y = 2.18932 + 3934.318 * X$

No. of points = 38



PM(G)/dscf @ 7% O2

Figure: 4

USEI & EPA

Combined Cadmium Data

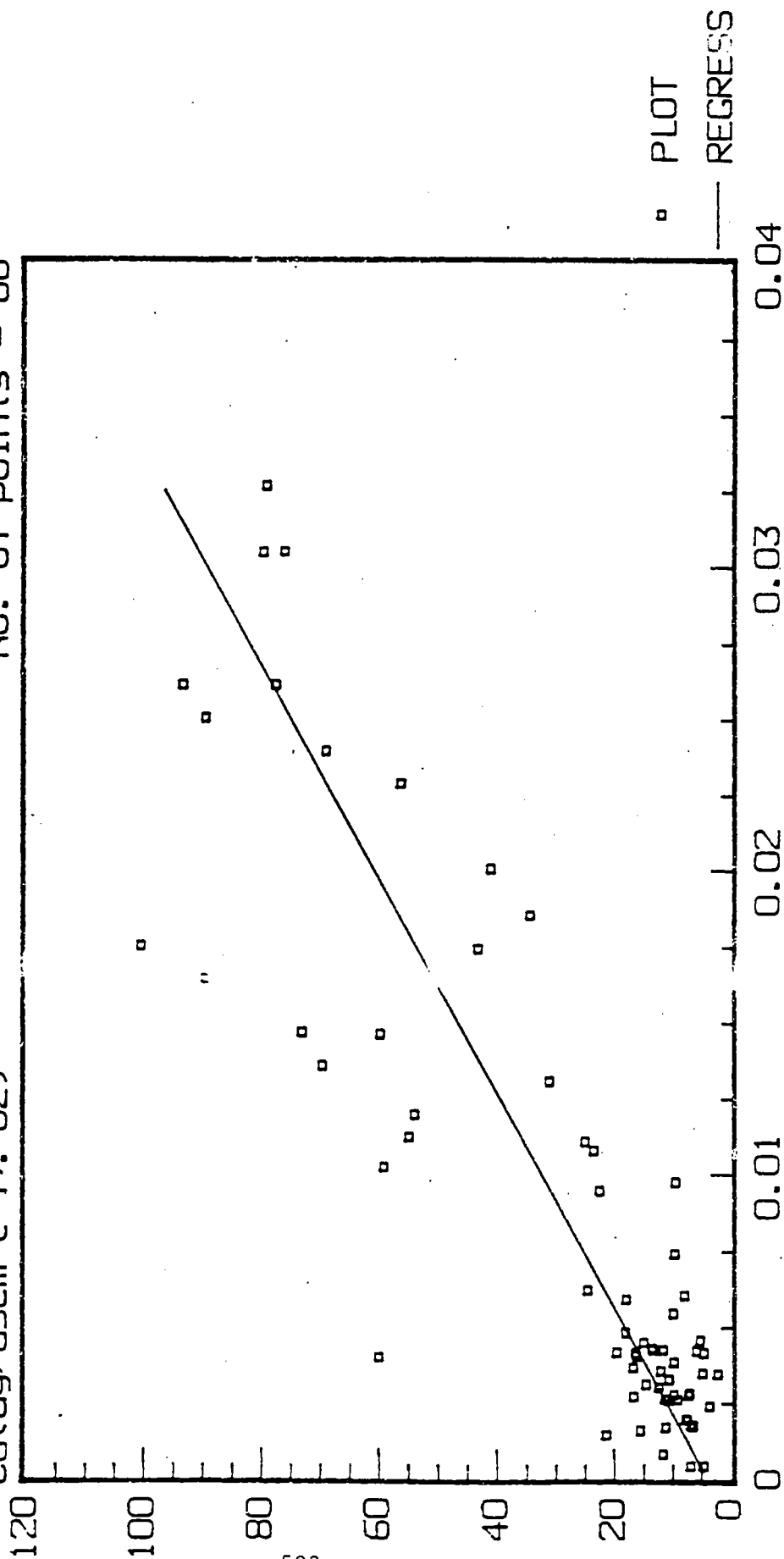
$R^2: 0.7431$

Corr.: 0.86203

Lin.: $Y = 4.00811 + 2845.211 * X$

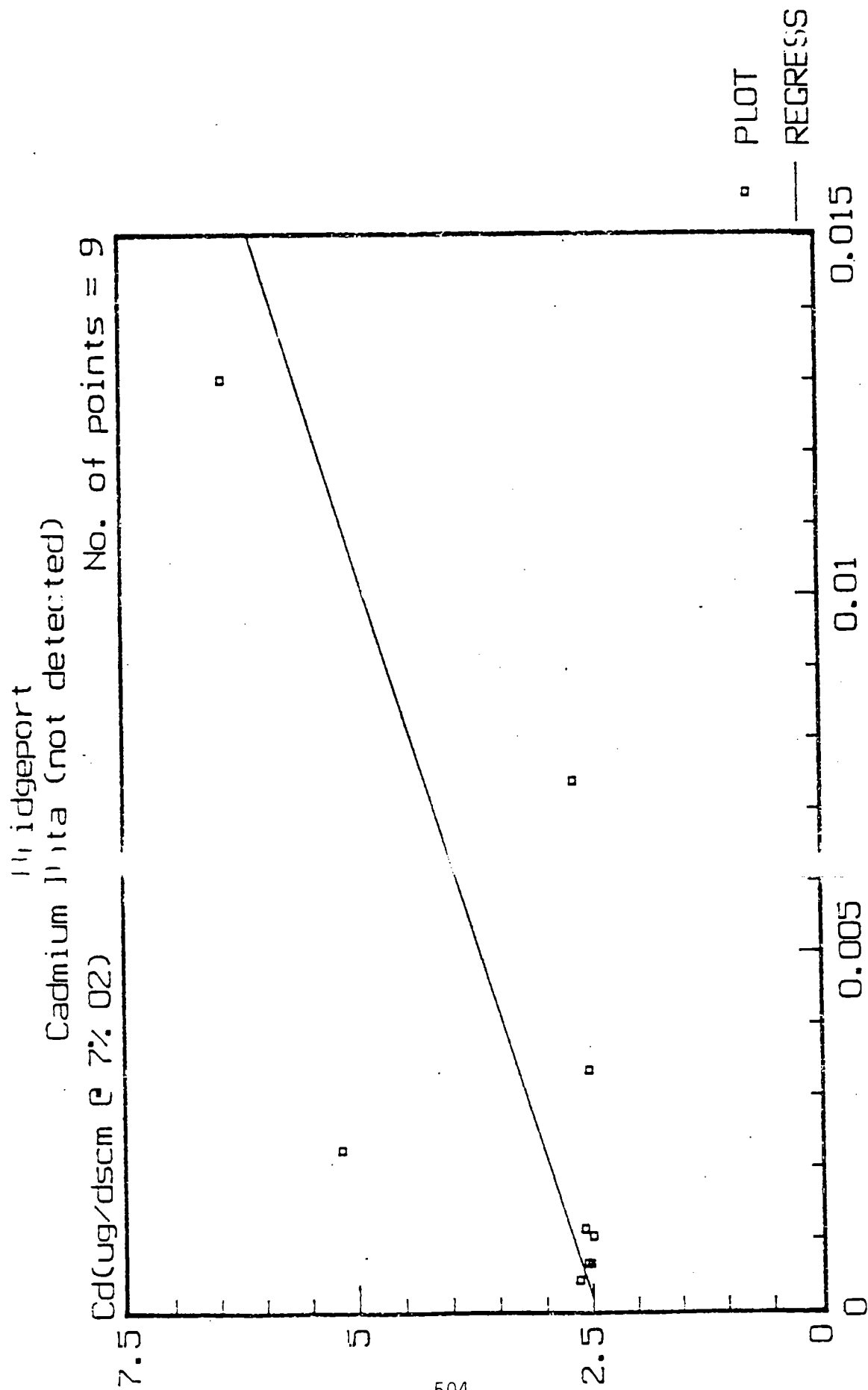
Cd(ug/dscm @ 7% O2)

No. of points = 68



PM(G/dscm @ 7% O2)

Figure: 5



PM(G/dscf @ 7% O2)
Figure: 6

Millbury Lead Data

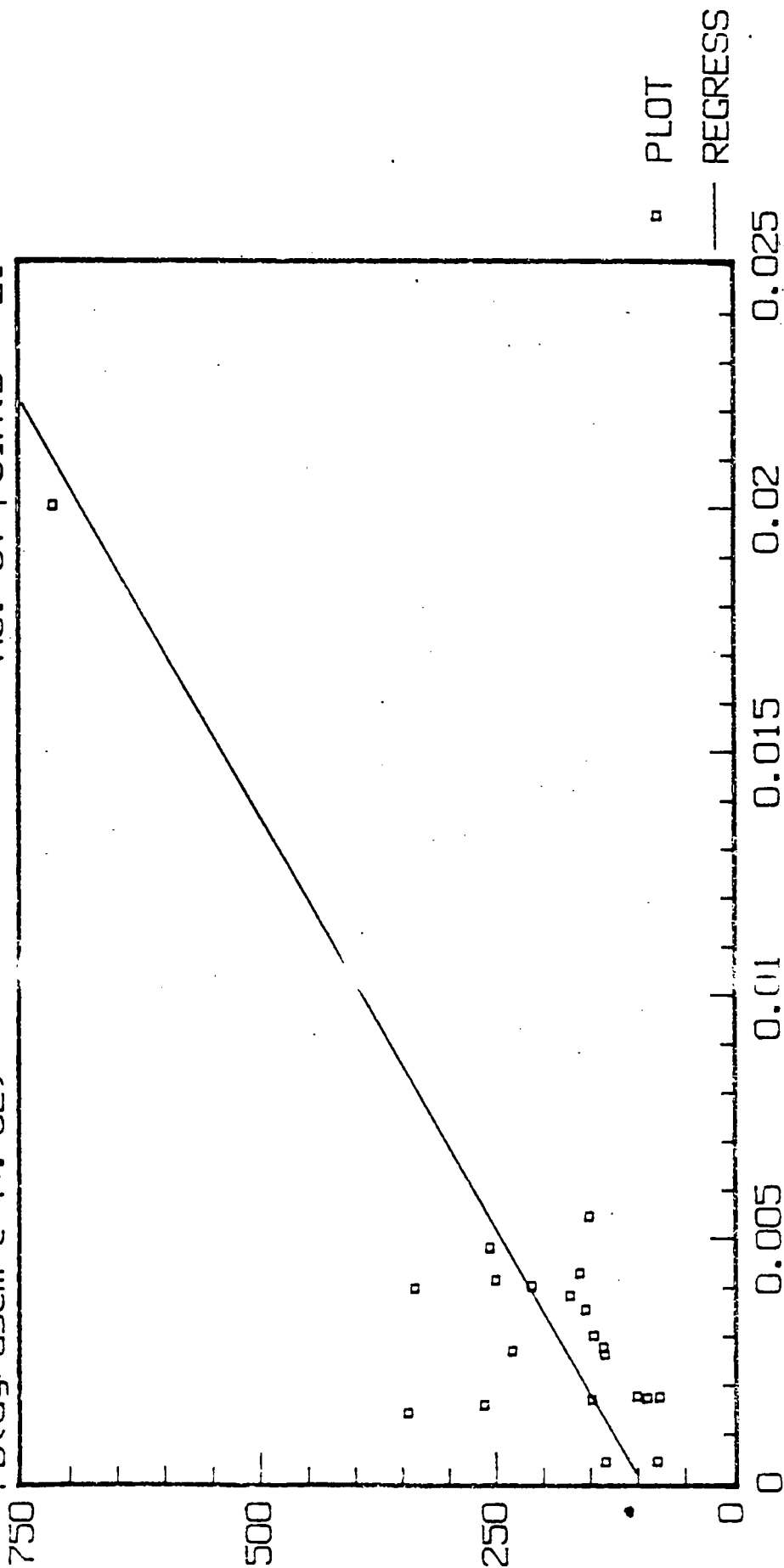
R²: 0.71301

Corr.: 0.8444

Lin.: $Y = 96.32925 + 29497.54 * X$

Pb(ug/dscm @ 7% O2)

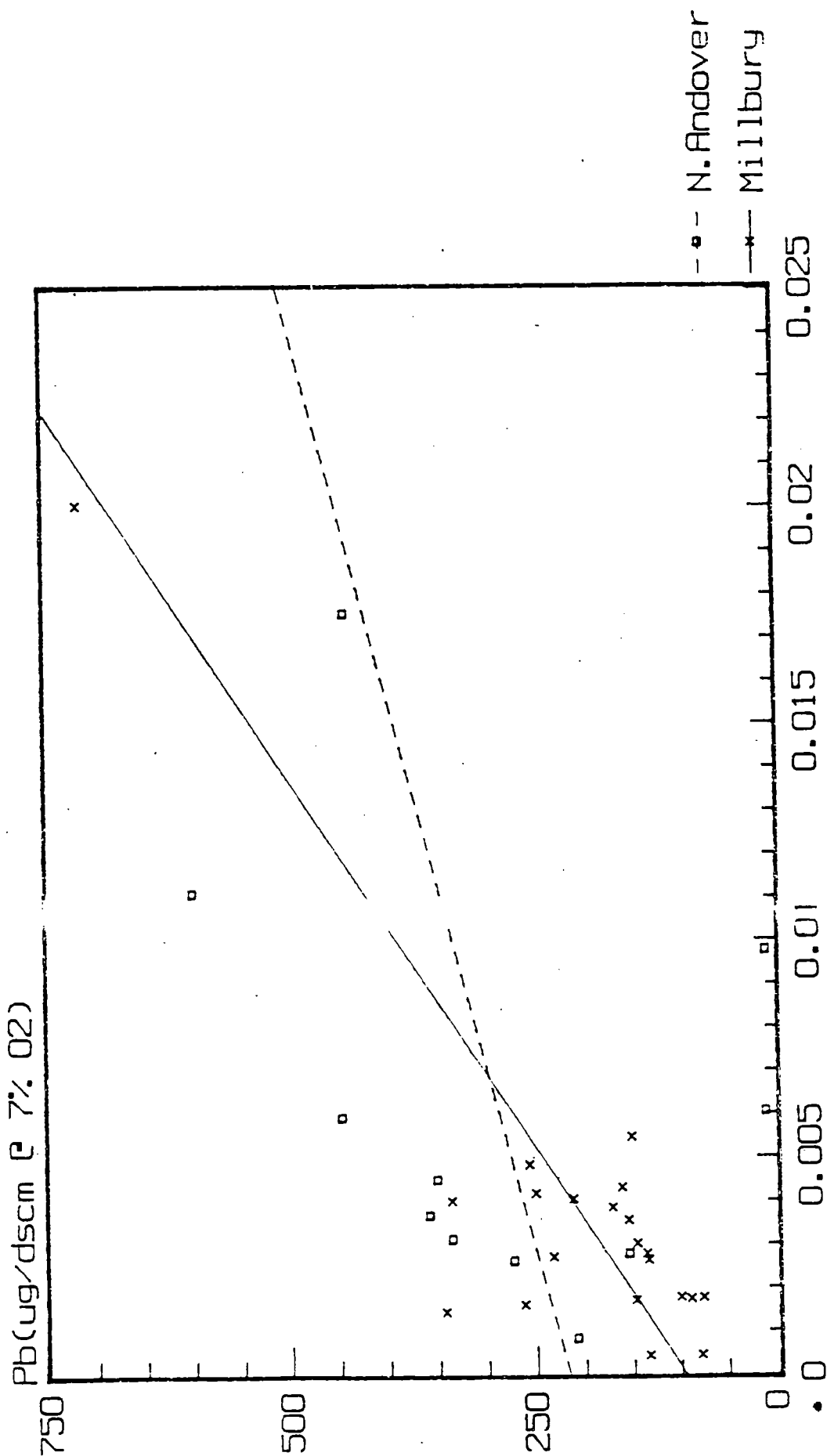
No. of points = 21



PM(G/dscf @ 7% O2)

Figure: 7

Millbury & North Andover Lead Data



PM(Gr dscf @ 7% O2)
Figure: 8

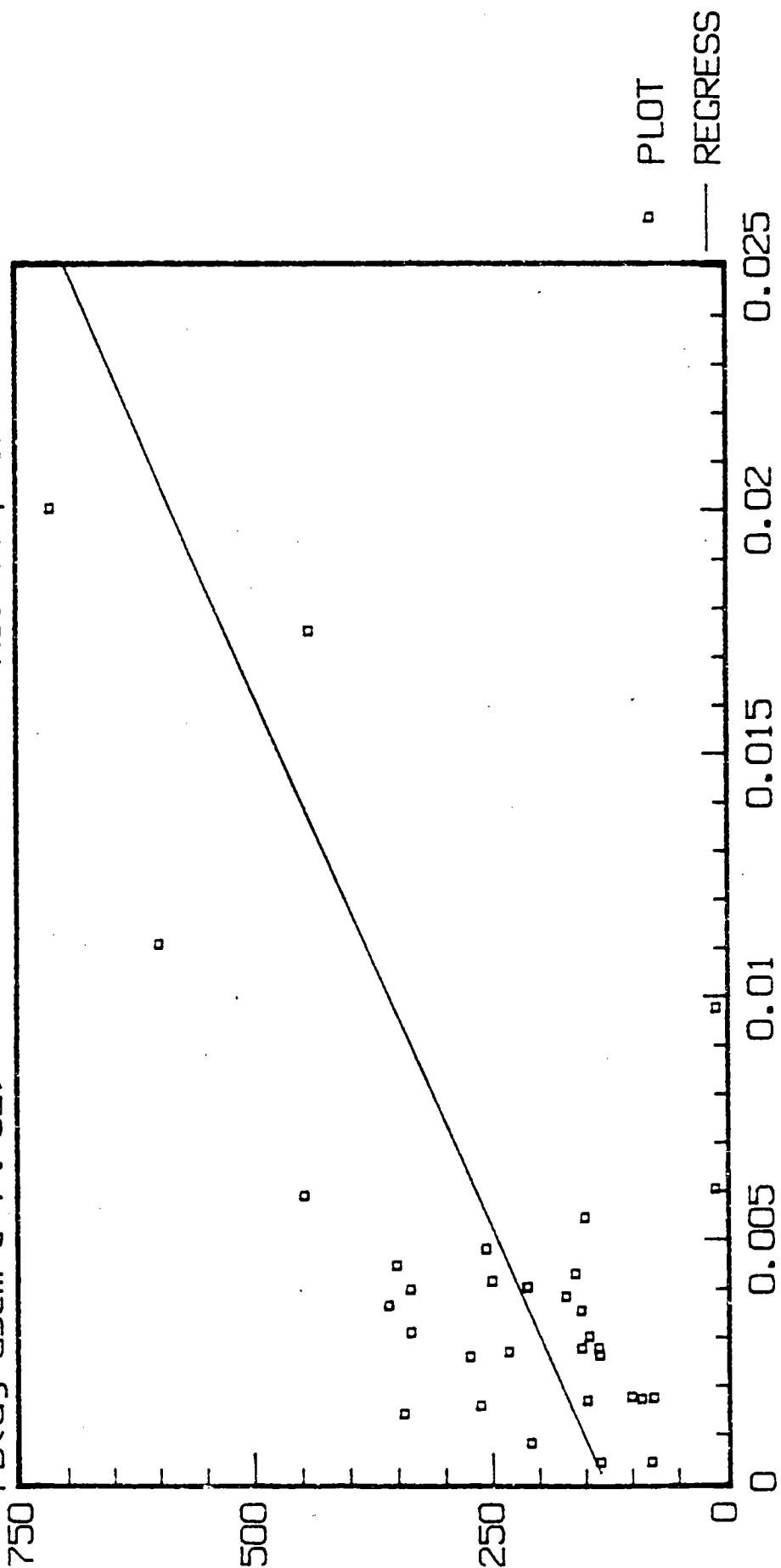
Millbury & North Andover
Combined Lead Data

R²: 0.40266 Corr.: 0.63455

Lin.: $Y = 130.1444 + 22796.96 * X$

Pb(ug/dscm @ 7% O₂)

No. of points = 32



PM(Gr/dscf @ 7% O₂)

Figure: 9

Millbury, North Andover, & Saugus
Lead Data

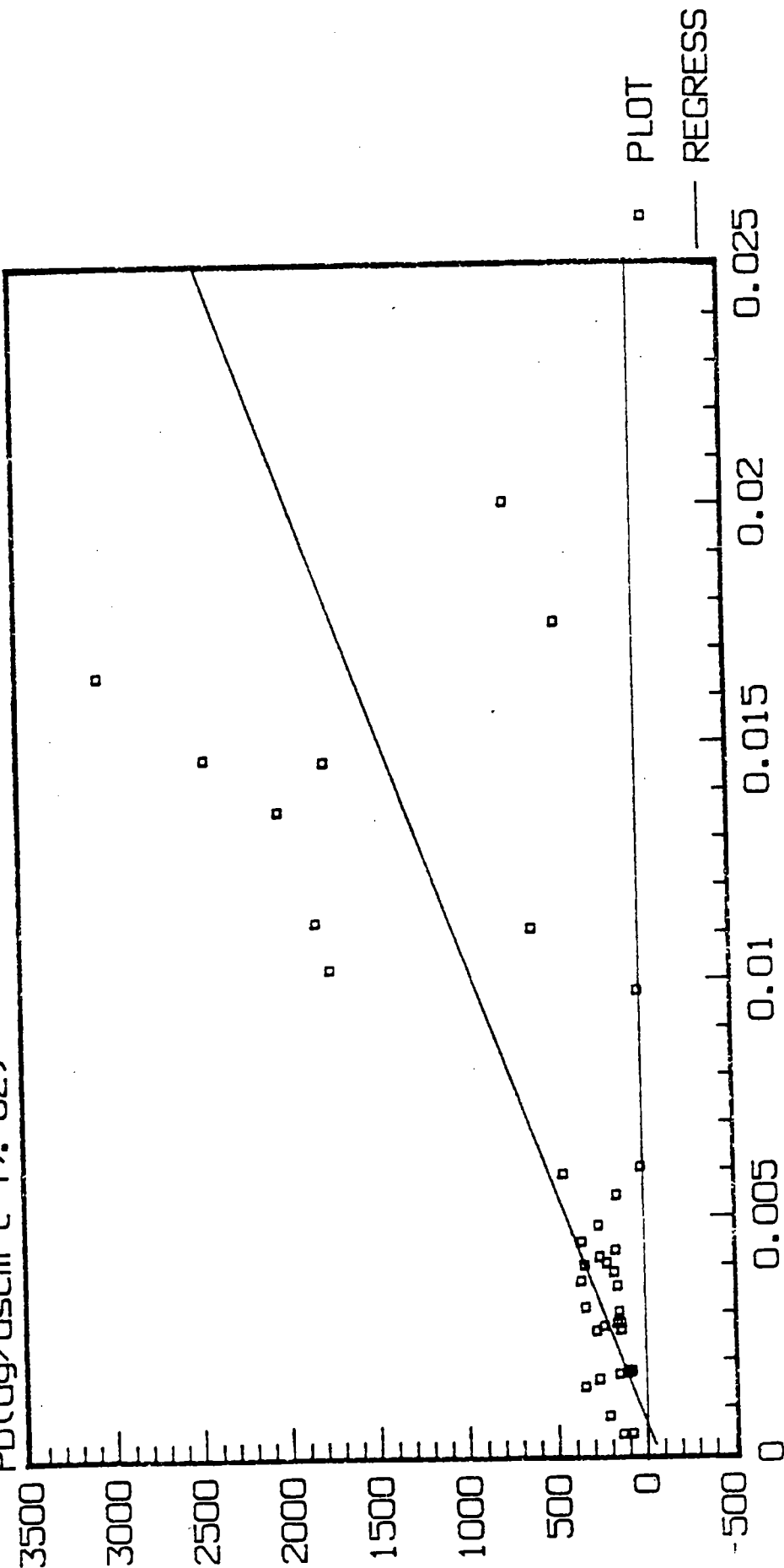
$R^2: 0.51656$

Corr.: 0.71872

Lin.: $Y = -62.12689 + 100618.2 * X$

No. of points = 38

Pb(ug/dscm @ 7% O2)



PM(Gr/dscf @ 7% O2)

Figure: 10

WESI & EPA

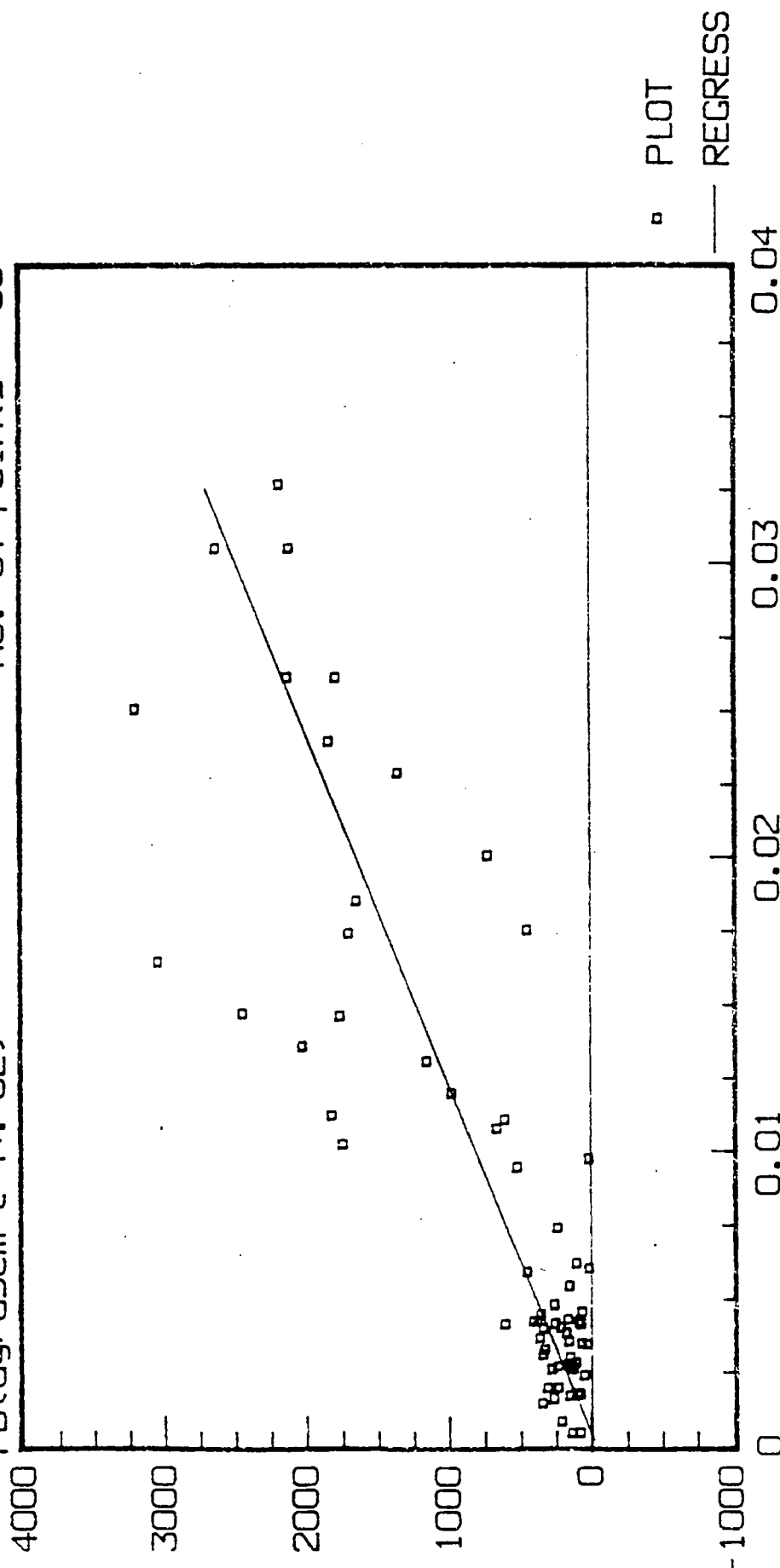
Combined Lead Data

$R^2: 0.71421$ $\text{Corr.}: 0.84511$

$\text{Lin.}: Y = -27.09271 + 83865.01 * X$

No. of points = 68

Pb(ug/dscm @ 7% O2)

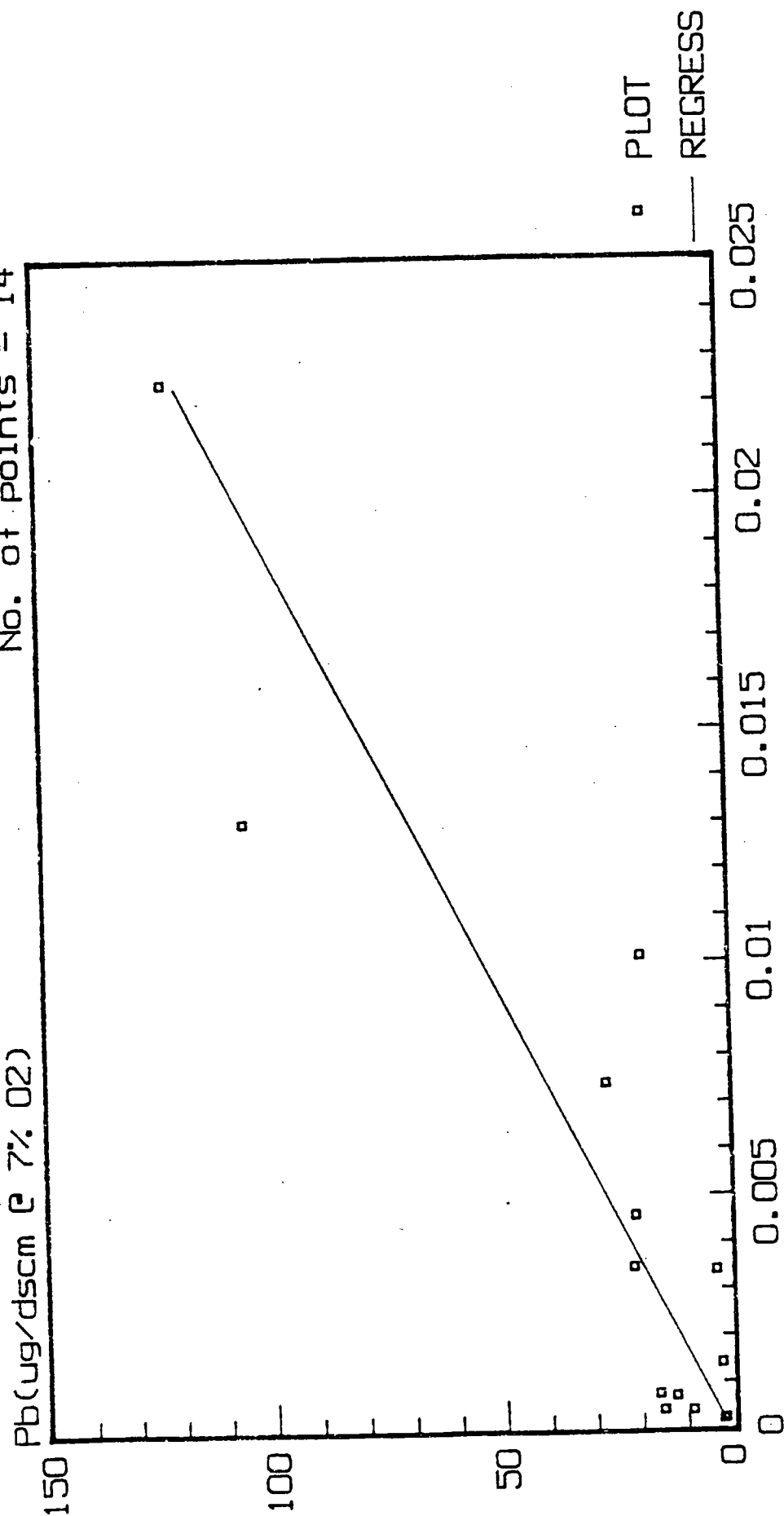


PM(Gr/dscf @ 7% O2)

Figure: 11

Bridgeport, Concord, & Gloucester
 Combined Lead Data (detect only)
 $R^2: 0.81511$
 $\text{Lin.: } Y = .92664 + 5270.205 * X$

No. of points = 14



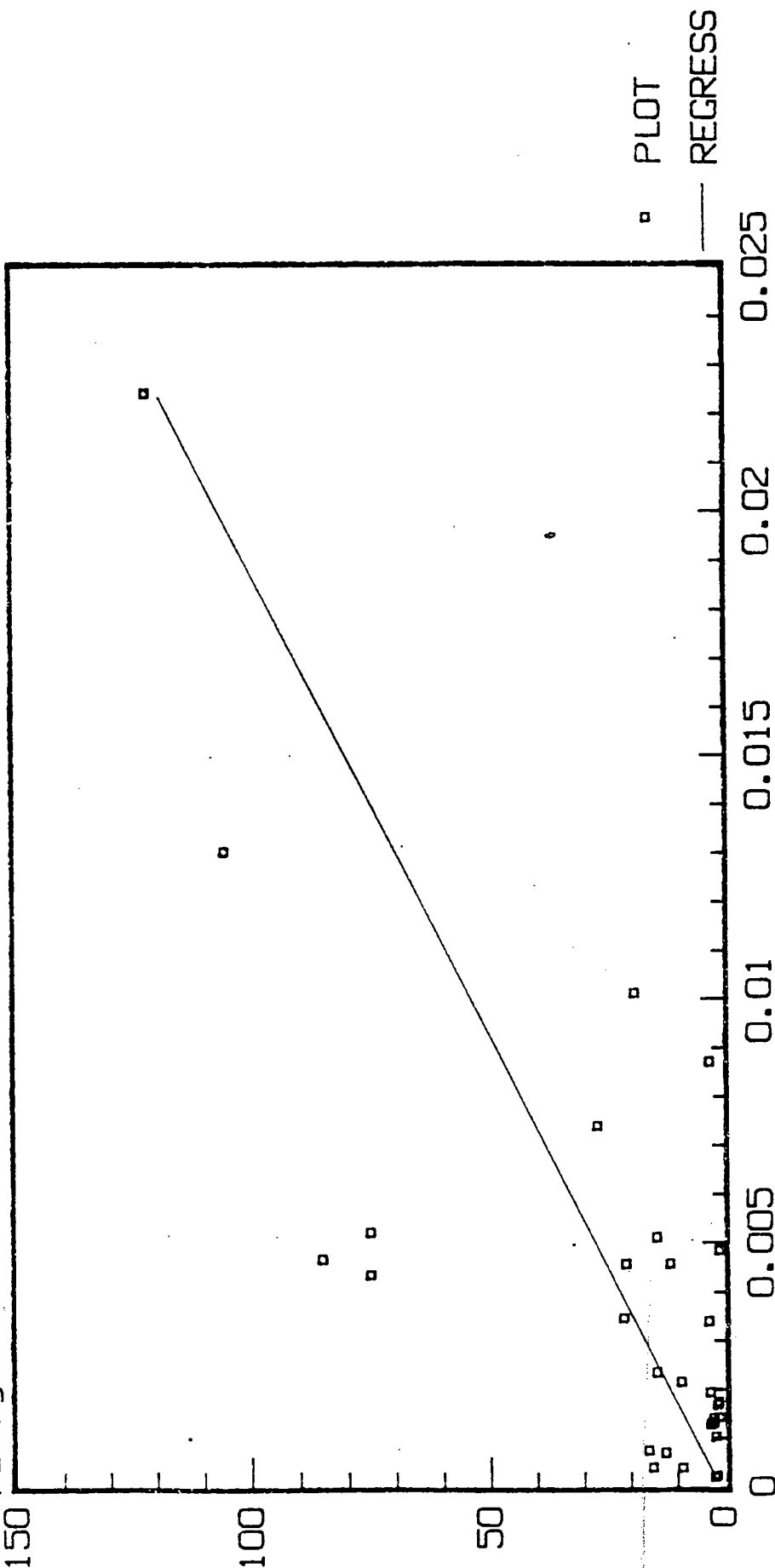
PM(Gr/dscm @ 7% O2)

Figure: 12

Vancouver, Wurzburg, Babylon, Hempstead,
 Long Beach, Bridg., Concord & Gloucester
 Lead Data R^2:0.53975 Corr.:0.7347
 Lin.: Y = .95129 + 5272.49 * X

No. of points = 31

Pb(ug/dscm @ 7% O2)



PM(Gr/dscf @ 7% O2)
 Figure: 13

XIII. TANK VESSEL STANDARDS

BACKGROUND INFORMATION AND REGULATORY ALTERNATIVES

EPA PRESENTATIONS

STATUS REPORT

MR. David Markwordt

Emission Standards Division
U.S. Environmental Protection Division
Research Triangle Park, NC 27711

(Slide 1)

I would like to present the status of our work to develop tank vessel standards for marine vessels transporting volatile organic compounds (VOC) and hazardous compounds (HAP).

(Slide 2)

I will review the background information, the sources of emissions, emission controls and their costs, and the preliminary regulatory alternatives for tank vessels. Tank vessels include both tankships and barges.

(Slide 3)

A brief history of the project is presented in slide 3.

(Slide 4)

Regulatory authority for controlling tank vessel emissions is provided under both Title I and Title III of the Clean Air Act Amendments. Title I mandates control of VOC's and other pollutants and calls for the promulgation of regulations within 2 years of enactment of the amendments. The tank vessel section of Title I applies to both nonattainment and attainment areas for both new and existing facilities. Title I requires both EPA and the Coast Guard to ensure compliance with the emission regulations.

(Slide 5)

Title III addresses hazardous air pollutants mandating MACT for 189 pollutants. Tank vessels carry products like gasoline and crude which have HAP constituents, as well as, pure chemicals listed in Title III.

(Slide 6)

We will now discuss the source and quantity of emissions.

(Slide 7)

Slide 7 presents a schematic of emissions from cargo loading. Product is pumped from shoreside tanks through the cargo loading header. As liquid fills the cargo compartments, vapors are displaced through the vent header.

(Slide 8)

The primary source of information for estimating emission and cost impacts were the National Research Council (NRC) Marine Board Study and the Waterborne Commerce of the United States (WCUS) data base. The NRC study provided the foundation for costs and the WCUS data base provided data for 1,800 terminals. Thirteen VOC-emitting commodity categories were reported for each terminal.

(Slide 9)

Slide 9 presents a summary of the throughput and emissions for each of the commodity categories as reported for the 1,800 terminals.

(Slide 10)

Slide 10 presents a summary of the emission factors (lb/1,000 gallons loaded) by tanker and barge for each of the commodity categories.

(Slide 11)

The data base has limited information with respect to specific chemicals listed in Title III. The commodity category for toluene also contained benzene. Toluene was estimated by prorating toluene and benzene production relative to the total throughput reported in this category. Over 250 chemicals were reported under the commodity category labeled chemicals, 60 of which are on the CAA list of 189 pollutants. The quantity of each chemical loaded is not known and some of the chemicals are actually loaded in containers versus bulk loaded. For the purpose of this study it was assumed that all throughput in the chemicals category is hazardous.

(Slide 12)

Emission controls and control costs will now be discussed.

(Slide 13)

Candidate control techniques are summarized in slide 13. The costing analysis presented here is based on incineration.

(Slide 14)

A simplified schematic of a shoreside vapor control system is shown in slide 14. Vapors must be collected from the vessel; therefore, the vessel will need to be retrofitted with a pipe vapor collection system if one is not present on the vessel. Vapors are routed to the shoreside vapor header piping system and finally controlled at the shoreside control device. Therefore, costs must be estimated for both vessel retrofit and shoreside controls.

(Slide 15)

The costing methodology is outlined on slide 15. Eight model terminals were developed one of which is selected for each of the 1,800 terminals based on terminal throughput of specific products. Capital costs for shoreside equipment is fixed for each of the models. But operating costs are based on the actual throughput of the terminal.

Each model terminal consists of a combination of 4 model vessels. The number of vessels is based on terminal throughput. And each model has specified capital and operating costs.

(Slide 16 & 17)

For example, capital and operating cost components are provided for model terminal 5A in slides 16 and 17 respectively.

(Slide 18)

The annualized dollars per ton of pollutant reduced versus terminal throughput is plotted in slide 18 for gasoline and crude loading operations. Cost effectiveness is a function of throughput i.e., as throughput increases cost effectiveness decreases.

(Slide 19 & 20)

After applying models and estimating emission reductions and costs of controls, different applicability options were analyzed i.e., which facilities will be controlled. Slide 20 lists different approaches to structuring the applicability of a regulation.

(Slide 21)

Preliminary regulatory alternatives are summarized in slide 21.

(Slide 22)

Some or all of the throughput at 144 facilities in 5 states are either affected by promulgated rules or may be affected if proposed rules are promulgated. For the purpose of this analysis these 144 facilities are assumed to be controlled. Therefore the emission reductions and control cost impacts are attributed to the State regulations and are not shown in slide 21.

(Slide 23)

The proposal and promulgation schedule is shown in slide 23.

NAPCTAC

TANK VESSEL

LOADING OPERATIONS

REGULATORY DEVELOPMENT

JANUARY 31, 1990

ORGANIZATION OF PRESENTATION

- ➔ ● BACKGROUND
- EMISSIONS
- EMISSION CONTROLS/COSTS
- PRELIMINARY REGULATORY
ALTERNATIVES

HISTORY

- **1986: NATIONAL RESEARCH COUNCIL (NRC) STUDY INITIATED**
- **1987: NRC STUDY COMPLETED**
 - **EPA TO SET UNIFORM EMISSION STANDARDS**
 - **COAST GUARD TO DEVELOP SAFETY REGULATIONS**
- **1989: EPA BEGAN WORK ON FEDERAL RULE**
- **1990: COAST GUARD PUBLISHED FINAL SAFETY REGULATIONS**
- **1990: CLEAN AIR ACT AMENDMENTS REQUIRE FEDERAL RULE IN 2 YEARS**

REGULATORY AUTHORITY

TITLE I: VOC CONTROL

- **MANDATES CONTROL OF VOC'S AND OTHER POLLUTANTS**
- **SCHEDULE: PROMULGATION IN 2 YEARS**
- **TANK VESSELS SECTION APPLIES TO BOTH NONATTAINMENT AND ATTAINMENT AREAS**
- **EPA AND COAST GUARD SHALL BOTH ENSURE COMPLIANCE**

REGULATORY AUTHORITY, CONTINUED

TITLE III: HAZARDOUS AIR POLLUTANTS

- **MANDATES MACT FOR 189
POLLUTANTS**

**MACT FOR NEW SOURCES: "BEST OF
BEST"**

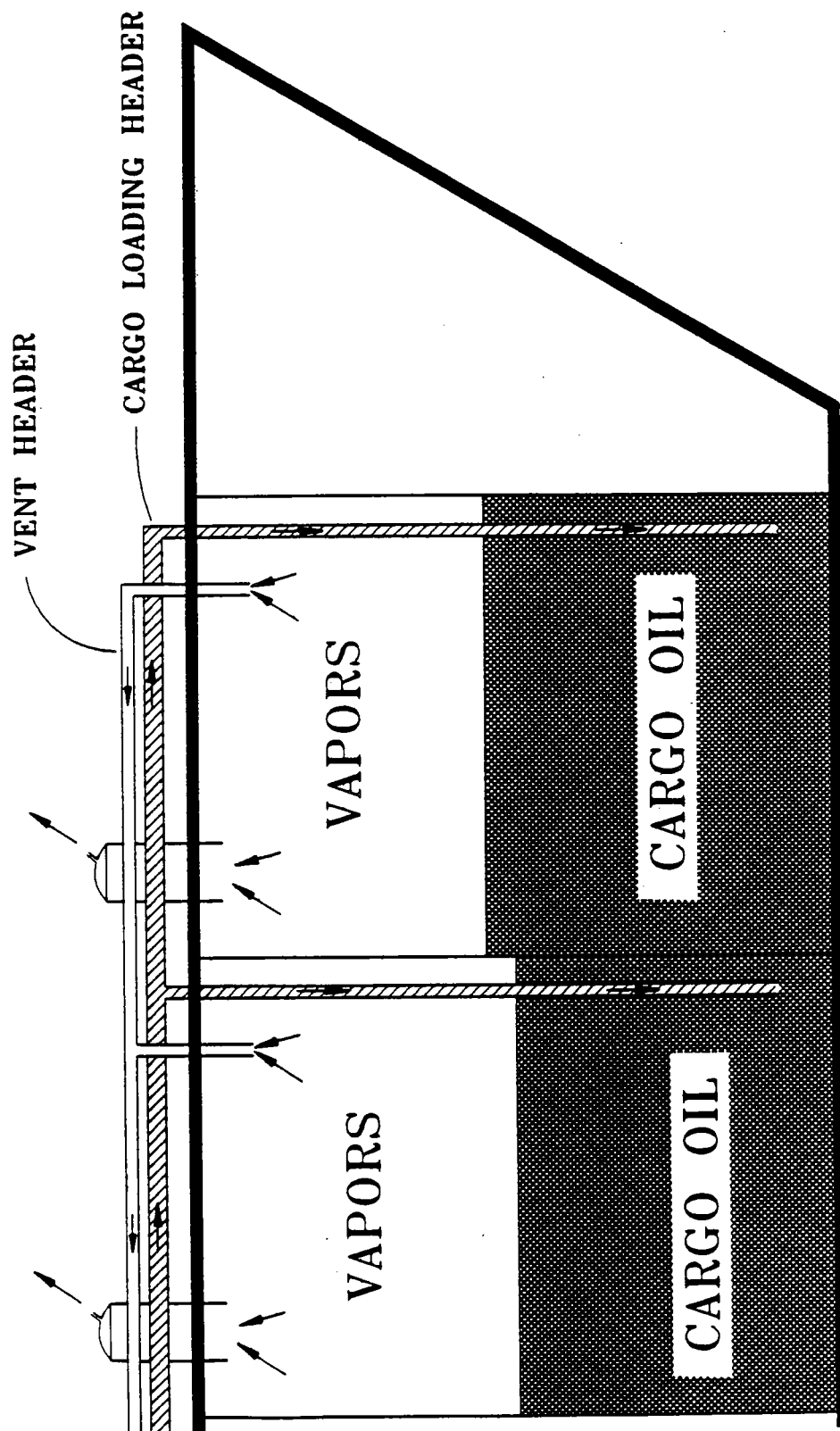
**MACT FLOOR FOR EXISTING
SOURCES: "AVERAGE OF TOP 12
PERCENT BEST CONTROLLED
SOURCES"**

- **NESHAP PROJECTS: HAZARDOUS
ORGANIC NESHAP (HON),
PETROLEUM REFINERIES, BULK
TERMINALS**

ORGANIZATION OF PRESENTATION

- ☐ BACKGROUND
- ➔ ☒ EMISSIONS
- ☐ EMISSION CONTROLS/COSTS
- ☐ PRELIMINARY REGULATORY ALTERNATIVES

EMISSIONS FROM CARGO LOADING



SOURCES OF INFORMATION

- **NRC (MARINE BOARD) STUDY:
CONTROLLING HYDROCARBON
EMISSIONS FROM MARINE VESSEL
LOADING**
- **WATERBORNE COMMERCE OF THE
UNITED STATES (WCUS) DATA BASE**
 - **1,800 TERMINALS**
 - **13 VOC-EMITTING COMMODITY
CATEGORIES**

COMMODITY CATEGORIES BY ANNUAL THROUGHPUT

COMMODITY CATEGORY	NO. OF TERMINALS LOADING	TOTAL NATIONAL THROUGHPUT (MM BBL/YR) ^A	ANNUAL EMISSIONS ESTIMATE (MG/YR)	PERCENTAGE OF TOTAL EMISSIONS (%)
GASOLINE	580	657	37,300	47.2
CRUDE OIL	397	1,312	37,400	47.2
JET FUEL	232	112	2,030	2.57
NAPHTHA, SOLVENTS	227	73	1,010	1.28
ALCOHOLS	226	49	978	1.24
TOLUENE	176	17	238	0.30
DISTILLATE FUEL	791	515	95	0.12
CHEMICALS ^B	658	286	27	0.03
OTHER ^C	403	59	6	0.01
KEROSENE	114	14	3	0.004
TOTAL		3,094	79,100	100

^AIN 1989.

^BINCLUDES "BASIC" AND "MISCELLANEOUS" CHEMICALS.

^CINCLUDES PETROLEUM AND COAL PRODUCTS, CRUDE PRODUCTS, AND GUM AND WOOD CHEMICALS.

ESTIMATED NATIONWIDE ANNUAL EMISSIONS

COMMODITY CATEGORY	NO. OF TERMINALS LOADING	EMISSION FACTORS, LB/1,000 GAL LOADED		PERCENTAGE OF TOTAL EMISSIONS
		TANKERS	BARGES	
GASOLINE	580	1.800	3.400	47.2
CRUDE OIL	397	0.610	1.000	47.2
JET FUEL	232	0.500	1.200	2.57
NAPHTHA, SOLVENTS	227	0.400	0.800	1.28
ALCOHOLS	226	0.500	1.200	1.24
TOLUENE	176	0.400	0.800	0.30
DISTILLATE FUEL	791	0.005	0.012	0.12
CHEMICALS ^A	658	0.005	0.005	0.03
OTHERS ^B	403	0.005	0.005	0.01
KEROSENE	114	0.005	0.013	0.004
TOTAL				100

^AINCLUDES "BASIC" AND "MISCELLANEOUS" CHEMICALS.

^BINCLUDES PETROLEUM AND COAL PRODUCTS, CRUDE PRODUCTS, AND GUM AND WOOD CHEMICALS.

COMMODITY CATEGORIES THAT INCLUDE HAZARDOUS AIR POLLUTANTS

- **TOLUENE**
- **"CHEMICALS" (INCLUDES OVER
250 REPORTED COMPOUNDS, 60 OF
WHICH ARE ON THE CAA LIST OF
189 POLLUTANTS)**
 - **QUANTITY OF EACH CHEMICAL
LOADED IS NOT KNOWN**
 - **SOME CHEMICALS ARE
ACTUALLY LOADED IN
CONTAINERS**

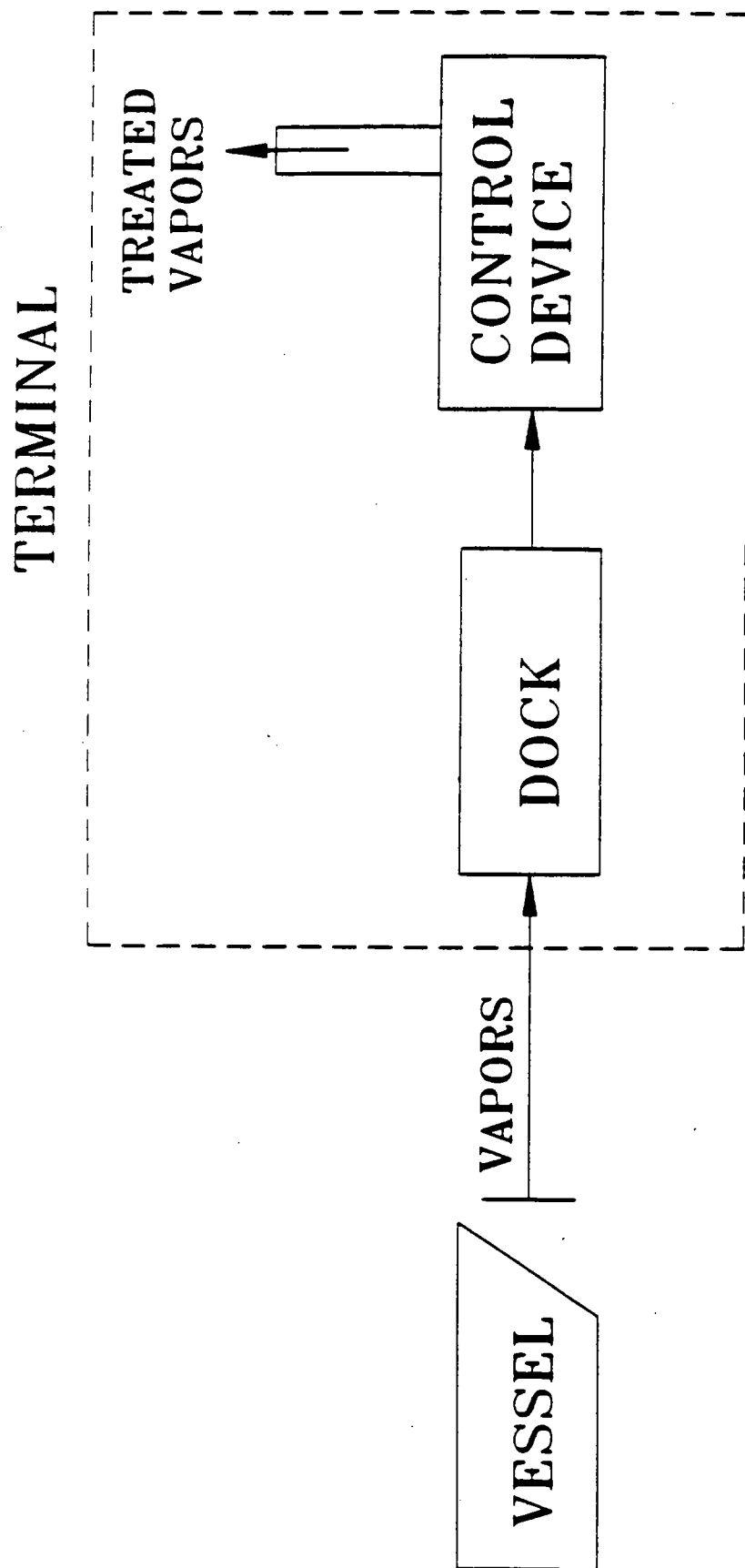
ORGANIZATION OF PRESENTATION

- BACKGROUND
- EMISSIONS
- ➔ ● EMISSION CONTROLS/COSTS
- PRELIMINARY REGULATORY
ALTERNATIVES

CANDIDATE CONTROL TECHNIQUES

CONTROL TECHNIQUE	CONTROL EFFICIENCY, PERCENT
● INCINERATION*	98
● FLARES	98
● CARBON BED ADSORPTION	95

* COSTING ANALYSIS IS BASED ON
INCINERATION



SHORESIDE VAPOR CONTROL SYSTEM

COSTING METHODOLOGY

TERMINALS

- **EIGHT MODEL TERMINALS**
- **CAPITAL COSTS FOR SHORESIDE EQUIPMENT**
 - **INCINERATOR**
 - **PIPING**
 - **ETC.**
- **OPERATING COSTS BASED ON THROUGHPUT OF ACTUAL TERMINAL**

VESSELS

- **FOUR MODEL VESSELS WITH ASSOCIATED CAPITAL AND OPERATING COSTS**
 - **CRUDE OIL TANKSHIP**
 - **PRODUCT TANKSHIP**
 - **CRUDE OIL BARGE**
 - **BARGE (PRODUCT OR CRUDE OIL)**
- **NUMBER OF VESSELS PER TERMINAL BASED ON TERMINAL THROUGHPUT**

CAPITAL COSTS: MODEL TERMINAL 5A

- **INCINERATOR**
- **INERT GAS GENERATOR**
- **WATER SYSTEM**
- **OTHER MAJOR EQUIPMENT**
- **PIPING**
- **INSTRUMENTATION**
- **ENGINEERING, STARTUP, AND CONTINGENCIES**
- **ASSOCIATED VESSEL TCI**

TOTAL CAPITAL INVESTMENT

$$\text{\$1,287,400} + 0.4603 \times \text{TP}$$

WHERE TP = THROUGHPUT = BARRELS/YR

ANNUAL COSTS: MODEL TERMINAL 5A

- **LABOR**
- **MAINTENANCE**
- **NATURAL GAS**
- **ELECTRICITY**
- **OVERHEAD**
- **PROPERTY TAXES, INSURANCE AND ADMINISTRATION**
- **CAPITAL RECOVERY CHARGE**
- **VESSEL RETROFIT TAC**

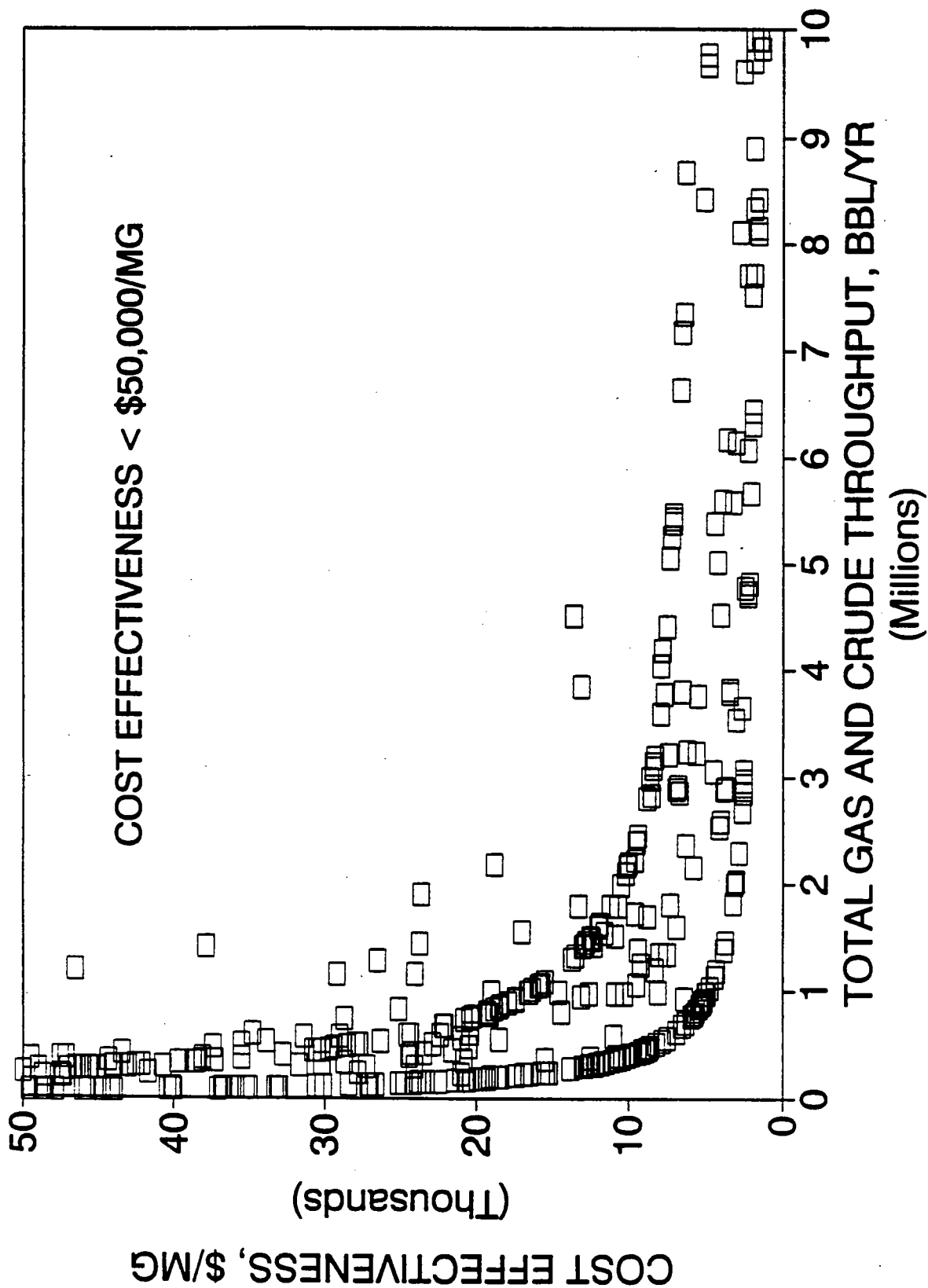
TOTAL ANNUAL COSTS

$$\text{\$311,700} + 0.08474 \times \text{TP}$$


WHERE TP = THROUGHPUT = BARRELS/YR.

COST EFFECTIVENESS VS THROUGHPUT

GASOLINE AND CRUDE OIL



ORGANIZATION OF PRESENTATION

- ☐ BACKGROUND
- ☐ EMISSIONS
- ☐ EMISSION CONTROLS/DATA
-  ☒ PRELIMINARY REGULATORY ALTERNATIVES

APPLICABILITY OPTIONS

- (A) GASOLINE ONLY, AT SPECIFIED THROUGHPUT**
- (B) CRUDE OIL ONLY, AT SPECIFIED THROUGHPUT**
- (C) GASOLINE AND CRUDE OIL ONLY, AT SPECIFIED COMBINED THROUGHPUT**
- (D) TOP SIX VOC-EMITTING COMMODITIES, AT SPECIFIED COMBINED THROUGHPUT^a**
- (E) ALL COMMODITIES, AT SPECIFIED TOTAL THROUGHPUT**

^aINCLUDES GASOLINE, CRUDE OIL, JET FUEL, NAPHTHA/SOLVENTS, ALCOHOLS, AND TOLUENE

PRELIMINARY REGULATORY ALTERNATIVES

ALTERNATIVES	VOC EMISSION REDUCTION, MG/YR	PERCENT EMISSIONS REDUCTION	NO. OF AFFECTED TERMINALS	COSTS, \$ MILLIONS		COST EFFECTIVE- NESS, \$/MG	HAP EMISSION REDUCTION, MG/YR
				CAPITAL	ANNUAL		
A. ALL TERMINALS	32,400	98.0	1,749	2,940	712	22,000	933
B. GASOLINE CRUDE OIL	>0.5 MM BBL/YR > 5 MM BBL/YR	73.4	90	308	73.5	3,000	595
C. GASOLINE GRUDE OIL	>1 MM BBL/YR >10 MM BBL/YR	68.1	57	239	55.5	2,500	553
D. GASOLINE	> 5 MM BBL/YR	42.8	22	105	22.0	1,600	372
E. GASOLINE	>10 MM BBL/YR	28.8	10	58	12.3	1,300	251

STATE/LOCAL REGULATIONS

- **FIVE STATES HAVE PROPOSED OR PROMULGATED A RULE**
 - ALASKA
 - CALIFORNIA (SCAB, BAAQMD)
 - LOUISIANA
 - NEW JERSEY
 - PENNSYLVANIA
- **144 TERMINALS AFFECTED**
 - ACCOUNT FOR 58.2 PERCENT OF NATIONWIDE EMISSIONS

PROJECT STATUS

PROPOSE RULE

FALL 1991

PROMULGATE RULE

FALL 1992

Recommendations Regarding Proposed E.P.A.
Marine Vapor Control Regulations

Presented by

Ross E. Hodges, P.E.
Technology Manager Vapor Control
John Zink Company

at

National Pollution Control Techniques
Advisory Committee Conference

January 31, 1991

Research Triangle Park, NC

As a designer/manufacturer of over 300 vapor control units operating worldwide in both land based bulk loading and marine facilities, John Zink Co. makes the following recommendations:

- I. The appropriate measure to judge performance of marine vapor control equipment is mass of pollutant per unit volume of product loaded.
 - A. A specified % efficiency is dependent upon inlet concentration. It is very difficult for manufacturers to guarantee efficiencies for this reason.
 - B. Figure 1 is an example showing that two different operators, while each complying with 98% efficiency can emit drastically different quantities of VOC's despite loading the same product and volume. On the other hand, limiting emissions to mass per unit volume loaded (say 10 mg/l) results in the same emission rate for both operators, which in John Zink Company's opinion is the only fair alternative.
 - C. The mass/unit volume basis has been used as the VOC emission guideline for gasoline bulk terminals for a number of years and is an acceptable measure of performance which can be guaranteed by equipment manufacturers.
 - D. The current U.S. E.P.A. guideline for VOC emission performance (excluding methane and ethane) for gasoline bulk terminals is 35

mg/l. Based on improvements that we have made in both vapor recovery and combustion technologies, we have consistently been able to attain better emission control. We have routinely achieved 10 mg/l or better in both carbon adsorption vapor recovery and enclosed temperature controlled vapor combustion units. The incremental capital costs in equipment to achieve 10 mg/l instead of 35 mg/l is no more than 10-15%.

- E. We suggest that performance testing be performed over the entire loading episode or the last 6 hours, whichever is less.

II. Both vapor recovery and combustion technologies are viable alternatives for marine emission control equipment. Where recovery technology exists, regulations should encourage vapor recovery rather than combustion.

- A. For motor fuels loading, both vapor recovery systems and enclosed vapor combustion systems can be designed and have been demonstrated to consistently achieve a maximum VOC emission level of 10 mg/l.

- B. Recovery systems have the following advantages:

1. Increased safety due to the lack of a continuous ignition source. This is recognized by Coast Guard which does not require maintenance of vapors outside the explosive range as it does with vapor combustion devices.
2. Recovery of valuable resource.
3. Avoidance of waste of enrichment gas to satisfy Coast Guard safety regulations and maintenance of necessary combustion temperature to attain high VOC destruction efficiency.
4. No tradeoff pollutants (NO_x , CO, CO_2) such as is the case with combustion equipment.

III. Open flame flares should not be permitted as the primary control device for marine vapor control applications. Logic dictates, in order to achieve reduced emission rates, temperature, time, and mixing control must be employed with combustion devices. This is not possible with open flame flares (as opposed to enclosed combustors).

- A. The basis for acceptance of open flame flares for terminal vapor emission control is to assume that they are at least 98% efficient based on compliance with four (4) design criteria, namely maintenance of minimum heating value, limiting burner velocity, monitoring pilot flame, and assuring smokeless operation. This assumption is based on very limited testing which was done at the John Zink Company Research Center in 1982 sponsored by the Chemical Manufacturers Association. These tests were done with pilot plant size equipment under controlled conditions with engineers and technicians operating the equipment.
- B. Our experience in real applications is that 98% reduction efficiency using open flame flares is probably not attained on a consistent basis. In the field, emission testing of open flame flares is practically impossible. Therefore, in the past, the E.P.A. has exempted these devices from direct emission testing requirements and has only required that the previously mentioned 4 design criteria be met. We have personally witnessed applications where all four design criteria were met, but the combustion efficiency was 0% (i.e. the main burners were not lit).
- C. Because the E.P.A. has exempted open flame flares from undergoing periodic direct emission testing, it has, unknowingly, promoted the use of these devices. Not only can the user minimize capital expenditures in the purchase of open flame flares, but also the significant costs associated with periodic emission testing required for the more efficient vapor recovery and enclosed vapor combustion devices. In our opinion, this is an error that needs to be addressed.
- D. The use of open flame flares should be limited to emergency release of hydrocarbons resulting from plant upsets (eg. refinery flares). They should not be used in controlled flow, non-emergency, vapor control applications such as terminal vapor control where alternative, more efficient technologies are available.

- IV. All permitted marine vapor control devices should be subjected to periodic testing which directly measures emission performance to assure continued compliance with E.P.A. regulations.
- A. In order to assure proper operator attention to vapor control equipment and compliance with E.P.A. regulations, it is our recommendation that these control systems be periodically tested directly for emission performance.
 - B. Emissions from Vapor Recovery and Enclosed Combustion Systems can be directly measured and, in fact, are being done in several states already. Direct emission testing from terminal open flame flares cannot be done accurately.

FIGURE 1
COMPARISON OF REMOVAL EFFICIENCY AND
MASS EMISSION PER UNIT VOLUME LOADED

Operator A

Assumptions:

Product Loaded: Gasoline
Loading Temperature: 60°F
Loading Pressure: 14.7 PSIA
Product RVP: 9.0 PSIA
Vapor Growth Factor: 1.0
Loading Rate: 20,000 BPH
Hydrocarbon Concentration in Vapor (assuming 1/4
of theoretical saturation): 7.8%
Hydrocarbon Vapor Molecular Weight: 65

Operator B

Assumptions:

Product Loaded: Gasoline
Loading Temperature: 110°F
Loading Pressure: 14.7 PSIA
Product RVP: 9.0 PSIA
Vapor Growth Factor: 1.0
Loading Rate: 20,000 BPH
Hydrocarbon Concentration in Vapor (assuming 1/4
of theoretical saturation): 19.1%
Hydrocarbon Vapor Molecular Weight: 65

Allowable Emissions Based Upon 98% Reduction

Operator A

Hydrocarbon To Vapor Control Device:
= (20,000 BPH) (5.615 ft³/BBL) (#MOL/379.49
SCF) (65#/#MOL) (.078)
= 1500 #/hr

Allowable Emission:
= 1500 #/hr (1-.98)
= 30.0 #/hr

Operator B

Hydrocarbon To Vapor Control Device:
= (20,000 BPH) (5.615 ft³/BBL) (#MOL/379.49
SCF) (65#/#MOL) (.191)
= 3674 #/hr

Allowable Emission:
= 3674 #/hr (1-.98)
= 73.5 #/hr

Allowable Emission Based Upon 10 mg/l Product Loaded

= (20,000 BPH) (158.99 l/BBL) (10 mg/l) (#/454,545 mg)
= 70 #/hr

DISCUSSION

Following the EPA presentation, Mr. William Dennison of the Committee asked if those facilities that load offshore will be covered under the regulation. Mr. David Markwordt responded that although EPA has not looked at these facilities specifically, EPA's regulatory authority extends out to 25 miles from shore. Mr. Dennison also asked if ballasting emissions would be regulated. Mr. Markwordt replied that the U.S. Coast Guard requirements regarding segregated ballast tanks have eliminated ballasting emissions from the vast majority of marine vessels.

Mr. Donald Arkell of the Committee asked if there was any language in the Clean Air Act (CAA) that specifically stated that a rule for marine vessels applies to both attainment and nonattainment areas. Mr. Arkell then asked if the cost-effectiveness values shown on the preliminary regulatory alternatives table (page 21 of the NAPCTAC package) were based on VOC or HAP emissions reductions. Mr. Markwordt explained that the cost-effectiveness values refer to VOC emissions and that the HAP emissions are part of the total VOC emissions.

Mr. Patrick Atkins of the Committee asked why EPA has only considered incineration, since many of the safety issues associated with incineration are not associated with carbon adsorption. Mr. Atkins also asked if EPA would write the regulation to allow for the use of carbon adsorption. Mr. Markwordt responded that EPA's estimated control costs were based on incineration because the previous study done by the Marine Board of the National Research Council (NRC) based its costs on incineration, and by using the information contained in this study, EPA was able to progress with the project more quickly. Mr. Markwordt emphasized that EPA does not endorse one technology over another. He added that the idea of "pollution prevention" is important and would be addressed. Mr. James Weigold, Committee Chairman, agreed that the issue of pollution prevention would be examined and stated that developing a regulation for marine vessels provides an excellent opportunity to explore the issue.

Mr. John Pinkerton of the committee asked if EPA is comfortable with the data base, specifically with regard to emission factors for chemicals loaded onto barges and the HAP emission estimates. Mr. Markwordt replied that he felt comfortable with the emission factors for gasoline and crude oil. He added that the emission factors for gasoline and crude oil were supported by test data collected at 31 refineries. Mr. Markwordt reiterated that emission factors for those commodities not having published emission factors were estimated by comparing the vapor pressures of those commodities with the vapor pressures of those commodities with known emission factors, and that he was comfortable using this approach. Mr. Markwordt

also explained that the data for the 1,800 marine terminals was obtained from the Army Corps of Engineers and that he felt that having specific data for all terminals resulted in more accurate emissions and cost estimates than did extrapolating data contained in responses to a few Section 114 information collection requests.

Mr. Pinkerton then asked how EPA would write a MACT standard (i.e., would it be written to control individual compounds). Mr. Markwordt replied that our current thinking is that we would initially select a regulatory alternative based on control of VOC's under Title I. A decision would be made under Title III separately to determine what, if any, additional controls would be needed to meet MACT requirements. Mr. Markwordt also said that addressing each compound separately under Title III would not be a logical approach. Mr. Weigold concurred with Mr. Markwordt that EPA must first look at a performance standard for VOC's and from there decide if HAP's will be regulated and at what level. Mr. Markwordt then informed the Committee that EPA is examining the data to locate those terminals with individual HAP emissions greater than 10 tons per year and those with combined HAP emissions greater than 25 tons/yr.

Mr. William O'Sullivan of the Committee commented that the State of New Jersey had permitted 19 vapor recovery units at 15 terminals. In addition, the State of New Jersey is allowing either a 95 percent emissions reduction or a mass emission limit of 10 milligrams (mg) per gallon of gasoline loaded. Mr. O'Sullivan cautioned against the use of incineration due to products of incomplete combustion, namely carbon monoxide; he added that the State of New Jersey has imposed carbon monoxide limits on incinerator users. Mr. O'Sullivan further stated that 50 percent of the permitted marine vessel emission control devices in the State of New Jersey were recovery devices (carbon adsorption), and 50 percent were for enclosed combustion devices (open flares are not permitted). Mr. O'Sullivan informed the Committee that the institutional preference of the State of New Jersey is carbon adsorption. Mr. O'Sullivan then asked if hatches on the vessels represent a leak source and if EPA planned to establish criteria on acceptable leak levels. Mr. Markwordt stated that equipment leaks were not a major concern and would be negligible compared to the total possible emissions; however, no data is available regarding hatch leaks.

Mr. Markwordt said that the final regulation for marine vessels will be similar to the benzene regulation. He explained that controlling emissions from marine vessels is a two-step process: the first step is to ensure good vapor collection at the vessel and the second step is to ensure good destruction or removal efficiency at the control device. He added that EPA's Method 21 could be used as a capture test at the vessel.

Mr. Ralph Hise of the Committee asked if EPA had included the cost of auxiliary fuel for the incinerator when developing control costs. Mr. David Kapella of Midwest Research Institute replied that the costs provided by United Technical Design (UTD) presented in the NRC study were based on the use of regenerative incinerators. He further explained that the UTD cost estimates were based on the assumption that the pilot light of the incinerator, combined with the high heat of recovery, provided enough energy to sustain combustion, and that industry literature supported this conclusion. Therefore, only the cost of the fuel needed to maintain the pilot light was included in the control costs.

Mr. Arkell asked if EPA was considering any technology for energy recovery such as routing the flue gases through a turbine. Mr. Markwordt responded that energy recovery techniques were possible but unlikely because (1) marine vessel loading is a batch process and (2) piping costs would be high.

Following the presentation by Mr. Ross Hodges of John Zink Co., Mr. Markwordt stated that a rule based on a percent emissions reduction would simplify monitoring requirements. He reemphasized that EPA's approach is to ensure good capture and demonstrate control unit performance. In response to Mr. Hodges' statements regarding his preference for a mass emission rate limit rather than a required percent emissions reduction, Mr. Markwordt stated that control units will likely be required to be tested for the purpose of demonstrating compliance during the last minutes of loading when hydrocarbon concentration and carbon adsorber efficiency are highest. Mr. Markwordt also stated that if terminals were required to control a number of different commodities, those terminals that load several different commodities would find it difficult to use carbon adsorption.

Mr. O'Sullivan commented that substantial testing of control unit performance was warranted given the high emissions and the few number of facilities. He stated that the State of New Jersey requires continuous emissions monitors to test for carbon monoxide in the flue gas of incinerators and for hydrocarbons in the outlet stream of carbon adsorbers; he added that the requirement for a continuous emissions monitor is based on the terminal's total emissions. In addition, Mr. O'Sullivan advised EPA to consider Mr. Hodges' suggestion regarding disallowing the use of open flares.

Mr. Hise asked Mr. Hodges if the carbon adsorbers would be designed for the highest possible flow and highest inlet gas temperatures, and, if so, would this pose a problem when the adsorber operates under other conditions. Mr. Hodges responded that the carbon adsorber is designed based on the assumption that the hydrocarbon vapor is saturated. He added that at lower

concentrations, a percent emissions reduction is difficult to guarantee.

Mr. Atkins commented that allowing different percent emissions reductions for different situations was not feasible, and, therefore, requiring a percent emissions reduction was more appropriate than imposing limits based on mass emission rates. He then asked how the incinerator can be designed with no auxiliary fuel when the concentration of the inlet gas will vary. Mr. Hodges stated that regenerative incinerators are designed for high concentration streams and that lean streams may not provide enough fuel. He added that because the Coast Guard allows enrichment of the vapor, John Zink tends to favor enrichment (rather than inerting or diluting) when designing their incinerators. Mr. Markwordt commented that EPA's cost estimates represented a worst-case scenario (i.e., they may be overstated) because many terminal owners would choose to enrich rather than inert the hydrocarbon vapors.

Ms. Vivian McIntire of the Committee asked if regenerative incinerators could be effective if the concentration varies. Mr. Hodges said that it was possible to design regenerative incinerators to handle changes in concentration, but that to do so would add to the complexity and cost of the system. Mr. Markwordt emphasized that EPA is interested in estimating nationwide cost impacts and that he expects various types of other control devices (i.e., other than regenerative incinerators) to be used by the industry. He reiterated that EPA is not promoting incineration; however, incineration may be more efficient for controlling multiple commodities.

Mr. Hise commented that it would be extremely difficult to design a carbon adsorber when a mixture of compounds is involved. Mr. Hodges responded that designing a carbon adsorber to control multiple compounds would certainly add to the complexity and cost of the system.

XIV. RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

PLEASE PRINT

NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
<i>Bundy</i>	<i>EPA</i>		
<i>RANDALL L BURDICK</i> <i>Randall L. Burdick</i>	<i>PANHANDLE ENERGY</i> <i>1221 MCKINNEY ST</i> <i>HOUSTON, TX 77010</i>	<i>713</i> <i>489-2213</i>	<i>1/29</i> <i>1/30</i>
<i>Kim Brown</i> <i>Durham</i>	<i>E. J. DUPONT</i> <i>P.O. BOX 80-721</i> <i>WILMINGTON DE 19887-0721</i>	<i>302</i> <i>999-2471</i>	
<i>Fred Dimmick</i>	<i>SDB - CAQPS</i>	<i>919 541</i> <i>5625</i>	<i>1/29-31</i>
<i>W P Cotton</i> <i>Petrolite Corp.</i>	<i>6910 E 14th St</i> <i>Tulsa OK 74112</i>	<i>918/836-1601</i>	<i>1/29-31</i>
<i>Joey Toney</i> <i>California Asbestos Products, Inc.</i>	<i>P.O. Box 52</i> <i>Copperopolis, CA</i> <i>95228</i>	<i>209-785-2201</i>	<i>1/29-31</i>
<i>Madeline Strum</i> <i>EPA</i>	<i>MD-13</i> <i>RTP NC 27711</i>	<i>919</i> <i>541 2383</i>	<i>1/29-1/30</i>
<i>Robert H. Dickinson</i> <i>Westvaco Corp</i>	<i>274 Park Ave</i> <i>NY, NY 10111</i>	<i>212</i> <i>638-5000</i>	<i>1/29/30</i>
<i>Ron Berglund</i> <i>Union Carbide</i>	<i>P.O. Box 8361</i> <i>Southern WV 25303</i>	<i>304</i> <i>747-4985</i>	<i>1-29-91</i>
<i>BARRY HENDERSON</i> <i>RJR TOBACCO Co</i>	<i>201 MAIN ST. 27102</i> <i>WINSTON-SALEM NC</i>	<i>919 7413834</i>	<i>1-29-91</i>
<i>Ellen Ducey</i>	<i>EPA - CAQPS</i>	<i>541-5408</i>	<i>1-29-30</i>
<i>David Svendsgaard</i>	<i>EPA CAQPS</i>	<i>541-2380</i>	<i>1-29-91</i>
<i>WCH/Hook</i>	<i>6100 Oak Tree Blvd</i> <i>Cleveland Ohio 44131</i> <i>BFA Building</i>	<i>216</i> <i>447-7725</i>	<i>2/1</i>
<i>Stephen Sider</i>	<i>Nat. Biot. & Coastal Res. Assn</i> <i>1500 Rhode Island Ave. NW</i> <i>Wash. DC 20005</i>	<i>202</i> <i>462-6272</i>	<i>att</i> <i>1-29/30</i>

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

PLEASE PRINT

NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Bob Nelson	10 PC AT 1500 Rhode Is Ave NW Wash. DC 20005	202 462-6272	1/29-30/91
JEFF MUFFAT 3M	P.O. Box 33331 21-2W-05 ST. PAUL, MN 55133	612 778-4450	1/29 - 1/30
Karin Ritter	API 1220 L St. NW Washington DC 20005	202 682 8472	1/29 - 1/30
Randall M. Stone	Pavi, Hastings, Janofsky & Walker 1050 Connecticut Ave N.W. Washington DC 20036	202 223-9000	1/29 - 1/31
RONALD N. ROBERTS	GE PLASTICS 5 H AVERY STS. PARKERSBURG, W.V. 26101	304 424-5450	1/29 - 1/3
Tim Mann IBM	208 Harbor Dr. Stamford, CT 06904	203 352-7947	1/29-1/30
Ralph W. Makinen American Sterilizer Co	2424 W 23RD St. Erie PA 16514	(814) 870-8198	1/29 - 1/31
Jodi Bakst Weinberg, Bergeson & Newman	1300 Eye St NW Suite 600E Washington, DC 20005	202 962-6573	1/29 - 1/30
Jerry E. Mosher American Foundrymen's Soc	505 STATE STREET DES PLAINES IL 60016	800-532- 4237	1/29 - 1/30
DENNIS MASARIK M & T HARSHBORN	33200 MERCANTILE BEACHWOOD, OH 44122	216 360- 5021	1/29 - 1/31
John Bunyak National Park Service	P.O. Box 25287 Denver, CO 80225	(303) 969-2071	1/29 - 1/31
LARRY J. ZITKI CHROMETEC INC	647 E. JORDAN ROAD MACEDONIA, OH 44050	216 439-3700	1/29 - 1/3
Richard C Heller Chevron	100 Chevron Way Richmond CA 94802	415 620-5695	1/29, 30, 31
Russell Young American Packaging	Grant & Cushman Philadelphia Pa 19114	215 697-5411	1/29

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JOHN W. TORRANCE ALLIED SIGNAL INC	P.O. Box 31 PETERSBURG, VA 23804	(804) 520-3567	1/29
Paul Tranter II BP Oil	200 Public Sq. Cleveland, OH	216 586-8122	1/29
HEATHER HOTMAN ARGONNE NAT'L LAB	9700 S Cass Ave ARGONNE IL 60439	(708) 772-6018	1/29
Bennett King Radion Corp		919 541-9100	1/29
Rob Kaufmann American Paper Institute	1250 Conn. Ave. NW. Suite 210 WASHINGTON, DC 20036	202 463-2588	1/29 - 1/31
Joe Ledwith Vista Chemical	900 Throckmole Houston, TX 77077	713 588-5446	1-29/1-31
Mary King Eli Lilly & Co	Lilly Corp Ctr. Indpls, IN 46205	(317) 276-9805	1/29, 1/30
Dan Dorie Polaroid	1265 Main St. Waltham MA 02254	617 654-6283	1/29/1/31 1/31
ANDREW J. MURPHY ACUREX CORP.	4915 PROSPECTUS DR DURHAM NC 27613	919-544 4535	1/29
Leslie M. Alexander Martin Franchises/One Hour Martinsburg	2005 Ren Ave. Cincinnati OH 45212	(513) 351- 6211	1/29 - 1/30
Clay Freeberg Chevron	Po Box 7924 San Francisco, CA 94120	415-894 6879	1/29
DON PIERRE JOHN CRANE INC	6400 W. OAKTON MOLTON GROVE, IL 60053	708-967- 3560	1/29/1/30
KATHRYN GUNKEL NATL ASPHALT PAVEMENT ASSOC.	5100 FORBES BLVD NAPA BLDG LANHAM, MD 20706	301 731 4748	1/29-30/91
ROBERT EATON NOVACOR CHEMICAL/POLYSAR	PO Box 51927 INDIAN CRCHARD, MA 01151	413 781-1441	1/29 - 31

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
STEVEN DALTON MOBIL O.I. CORP	P.O. Box 116 STATEN ISLAND NY 10307	718-966-2017	1/29/91 - 1/31/91
PANKAJ DESAI CHEMROX, INC.	217 LONG HILL CROSSRD SHELTON, CT 06484	(203) 926-9081	1/29/91 1/30/91
THOMAS GUNTHER BUREAU DE RECHES	2401 E. ST. N.W. WASHINGTON D.C.	202 634-1249	1/29/91 1/31/91
HARRY HOVEY TRC ENV. CONS.	120 DEERBOST DR TROY NY 12180	518 283 872 2	1/29 1/30 1/31/91
Larry Runyan AFMA	P.O. Box HP 7 High Point NC 27261	919 884 5000	1/29 1/30
SHARI LIBICKI ENVIRON	5820 Shell mound rd. Emeryville CA	415 655 7400	
Barbara McGuinness DuPont	1007 Market St BOD Wilmington DE 19898	302 773 6209	1/29 1/30
Robert H. Hiss ATM	2964 Falmouth Cleveland, Ohio		
CHUCK GRIGSBY BASF CORP	8 CHAMPS DR PARSIPPANY, NJ 07054	201 397 280 3	1/29 1/30
Tosha Bloom Beveridge Diamond	1350 I St. NW Suite 700 Wash. DC 20005	(202) 789- 6000	1/29-31
TIM PLANKER Dusen	1550 INDUSTRIAL DR OWENSSO MI 48867	517 725-8184	1/29-1/30
Edwin T. Still Kerr-McBee Corp	P.O. Box 25861 OKlahoma City, OK	405 270-2431	29-30 Jan
Jane Oberick Texas Instruments	P.O. 2708 Burning Tree McKinney, TX 75070	214 497- 5411	1/29-30
Kathy Metcalf Sun Company	1801 Market St-10 Rm Philadelphia, PA	215 246- 8334	1/29-30

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Allen Ammerman Griffith Micro Science	7775 QUINCY WILLOWBROOK, IL 60521	708-325-6994	1/29 - 1/31
Karen Fidler Chem Mfrs Assoc.	2501 M Street NW Wash DC 20037	202 887 1176	1/29 - 1/31
BARBARA BANKOFF	3733 YUNA ST, NW D.C. 20016	202 364-9460	1/29
GARY O'DEA CHEMICAL MAN. ASSOC	2501 M ST., NW WASH. D.C. 20037	202 887 1353	1/29 - 1/30
Kathy Bailey Chem. Mfrs. Assn	2501 M St NW Wash, DC 20037	202 887 1186	1/29 - 31
GEORGE WALSH ENTROPY	Box 12291 RTP NC 27709	919 781 3550	1/29 - 1/30
JF ANDERSON FIRST CHEMICAL CORP	PO Box 1427 FASCAGUELLA MS 3947	601 438 2227	1/29 - 31
Gail Lacy EPA / SDB	MD-13 RTP, NC	541-5261	1/29 - 1/30
Kaye Harner EPA / SDB	MD-13 RTP, NC	541-3190	1/29
James F. Murphy Jr W.R. Grace & Co.	35 Hayden Ave LEXINGTON, MA 02173	617-861-6600	1/29
Nancy Cookson CMA	2501 M St, NW Wash DC	202-887-1241	1/29 - 31
ANNETTE STANLEY CMA	2501 M ST. NW WDC 20037	202-887-1105	1/29 - 1-30
TED CROMWELL CMA	2501 M ST NW Wash. D.C 20037	202 887-1383	1/29 - 1-31
LINDA CHAPLET EPA	MD-13 RTP, NC 27711	919 541-5358	1/29 - 1/30

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Kenny Braxton AMSCO	1002 LUPKIN RD. P.O. Box 747 Apex N.C. 27502	919 362-0842	1/29 & 30
Lawrence Laabs A.E. Staley	Decatur, IL	(217) 421-3181 321-4218	1/29-30
Roger Allen ABB-ES	6320 Gwendolyn Dr. Suite 100 Chapel Hill, NC 27514	919-493- 2471	1/29
Carol Athey Midwest Research Institute	401 HARRISON OAKS Blvd. Cary NC 27513	677-0249	1/29
JOHN O'CONNOR RADIANT	PO BOX 13000 RTP, NC 27709	541-9100	1/29
Ann Pope TSO/OAQPS	MD-14	541-5323	1/29
Jonathan Greenberg Browning Ferris Industries	Suite 500 1150 Connecticut Ave NW Washington DC 20036	202 223-8151	1/29
Tim Smith EPA/OAQPS	MD-13 RTP, NC 27711	919 541-5346	1/29
Marty Spitzer OPPE/OPP	401 M Street SW Rm 219 Wash DC 20460	FTS 245- (202) 4342	1/29 & 30
Bob Schell ABB Environmental	6320 Gwendolyn Dr Suite 100 Chapel Hill NC 27514	(919) 493-2471	1/29
Andrew Chis EPA/CPPE/OPA	HLI-221 HQ	202 245- 5729	1/29-1/31
Susan Fields Radiant Corporation	PO Box 13000 RTP, NC 27709	919 541-9100	1/29-1/31
Wayne Powell LEADS/SL	P.O. Box 48 Durham, N.C. 27606	919- 700-7100	1/29-1/31
Ralph Robinson System Applications	4600 Marshall Dr Suite 403 Raleigh NC 27612	762-1033	

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Sims Roy EPA OARPS	USFPA SDB-6ND13) RTP NC 27711	419-34- 5265	1/29, 30
A. Dusetzina	EPA MD13 RTP 2771	419 3411 5338	1/29
Fred Hanchman EPA/HAPS	USEPA HAPSIPAS (MD-13) RTP NC 27711	541-5339	1/29
TOM COERVER LA DEQ - AIR QUAL.	Box #4096 70804 BATON ROUGE LA.	(504) 342-8412	1/29
John Michelitsch EPA/OAQPS	U.S. EPA CAHDS-ESD-ID364D-13) RTP NC 27711	(919) 541-5437	1/29
John Robbins Abbott Laboratories	D-67C, Bldg 4P4A Abbott Park IL 60064	708- 937 0012	1/28-29
William D. Goins DCD - DASDC(E)	206 N. Washington St Alexandria 22034	703 325- 2215	1/29-31
LEE PAGE EPA REGION IV	345 COURTLAND ST. ATLANTA GA 30365	(404) 347-2864	1/29 - 1/31
DAVID GUSTAFSON DCM CHEMICAL	2030 WADSWORTH MIDLAND MI 48674	(517) 636- 2953	1/29-1/31
KENNETH NICHOLS ASBESTOS INFORMATION ASSN	1745 SEFF DAVIS HWY #509 ARUNDEL IA 2202	703/979- 1150	1/29-31
JOHN T. WELCH SAFE Corp	100 Cherry St 2d 100 Cherry St 2d	201 746 471	1/29, 30
Ed Rosenberg Occidental Petroleum	1747 PENN. AVE NW WASH DC 20545 WASHINGTON DC 20545		
Beth Fisher Hill-Hill-Signet	1000 1st St NW WASH DC 20004	202 775 3000	1/29-30
John Pinkerton NCASI	260 Madison Ave NY NY 10016-2401	212 532 9047	1/29-31

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Chuck Collins State of Wyoming Air Quality Div.	122 W. 25th St. Cheyenne WY. 82001	307-777-7391	1/29-31
Bob Strietur Amer. Petrol. Inst.	1220 L St. NW Wash., D.C. 20005	202-682-8353	1/29-31
Terry Richey Dexter Corp	1 E. Water St. Waukegan IL 60085	708/623-4200	1/29 & 30
R.L. Mikkelsen Alaska Pipeline Service Company	1835 S. Bragaw Anchorage, AK 99512	907 265-8437	1/29-31
Gil Vinzani State of North Carolina Dept of Commerce	430 N. Salisbury St. Raleigh, NC 27611	919 733-4967	1-29/30
Alvin Chow EPA	SDB-DAGPS	541-5626	1/29
Judy Graham EPA/ORD/HEA	EPA MD 52 RTP	541-0349	1/29
Jim Weigold EPA/CASPS/ESD	MD-13	541-5642	1/29-31
Gene Smith EPA	ESD, MD-13 RTP, NC		
Joe Dileo CLEAN AIR ROBOT	225 JEFF DAVIS HWY ARL, VA 22202	703-892-1816	1-29-30
Tam Mauer	SDB/ESD MD-13 RTP, N.C.	541-5254	1/29-31
MELISSA WATKINS	EPA/TSD MD-14 RTP, NC 27711	919	1/29
Loren Blanchard EPA	MD-13 RTP, NC 27711	919-5503	1/29
Johnathan LAWRENCE WATKINS	101 CLARKMAN AVE NW WASHINGTON, DC 20004	202-637-5338	1/29-1/31

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
William F. Johnson EPA	712 Pennsylvania Ave NW Washington, DC 20002	202-555-5555	1/29
BOB KECCAN EPA	MD-13 RTP NC	919-541-5749	
Tim Johnson EPA	MD-13 RTP NC	919-541-5749	1/29
F. C. L.	MD-13	919-541-5749	1/29
Walter	PO Box 4335 Chapel Hill NC 27519	919-467-6233	1/29
BOB ATAX	P.O. Box 14001 Research Triangle Park 27709	919-361-2005	1/29
Dianne Barne	EPA/CAGPS DAB	541-5749	1/29
Don F. Johnson	1001 Pennsylvania Ave NW Washington DC 20004	202-638-5500	1/29
William F. Johnson	EPA/CAGPS DAB	541-5749	1/29, 1/30
William F. Johnson	EPA/CAGPS DAB	541-5749	1/29
Peter Luedtke Holland & Hart	1001 Pennsylvania Ave NW Washington DC 20004	202-638-5500	1/29
Bill Thannett	MD-13 RTP NC	919-541-5749	1/29
Tom L. L.	MD-13 RTP NC 27711	919-541-5749	
GREG GASPARECZ LANIER & ASSOCIATES	4101 MAGAZINE ST NEW ORLEANS, LA 70115	(504) 895-0368	1/29 - 1/31

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Terry Hammond-Smith Environment Reporter	PO Box 51244 Raleigh NC 27609-0244	919 876-7378	1-28 to 1-31
RICHARD G. MOENCH ELI LILLY + CO	PO BOX 99 CLINTON, IN 47842	317 832-4409	1-28 - 1-30
MOHAMED A. SERAGELDIN USEPA	USEPA / OAQPS MD-13 RTP, NC 27711	919 541-2379	1-28/-29
Karen Cellitt USEPA	11	919-541- 0835	1-28, 29
Jerry M. Schroy Monsanto	800 N. Lindbergh Blvd St. Louis, MO 63167	314 694 6174	1-29 to 31
Dennis Brunwell Hunter & Williams	707 E Main Richmond, Va	804 798 7381	1-29 - 31
Russell Creighton Oakmore Associates	6114 LaSalle Ave Suite 353 Oakland CA 94611	415-531- 2099	1/29-31/91
Marshall Rackley Triangle Envir. Engrs	P.O. Box 4887 Cory, NC 27519	919 380-7438	1/29-30
Robert Currie Baxter Healthcare Corp	One Baxter Pkwy Deerfield, IL 60015	708 948-4097	1/29-1/31
Elaine Manning USEPA	MD-13 RTP 27711	919 541-5499	1-29-91
DAVID A. JAMET FIBER INDUSTRIES (AFMA)	P.O. Box 2000 Florence, SC 29502	(803) 395-3369	1/29-30
DAVID EMERSON AIR PRODUCTS AND CHEMICALS	7201 Hamilton Blvd Allentown PA	(215) 481 8347	1/29 - 1/31
REGINA BROWN ZIMMER	P.O. Box 10 DOVER, OH 44622	216 343-8801	1/29-30
DR. JOSEPH A. SENECA FENVAL SAFETY SYS.	700 NICKERSON RD. MARLBORO MA 01752	508/429- 3190	1/29-31

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Mrs Carol Niemi The Dow Chemical Co	2020 Abbott Rd, Lab 13 Midland, MI 48674	517-636-1636	1/29-30
Tom Kiffelman Du Pont	1379 Louviers Milton Cross Rd. Newark, DE 19714-6090	(302) 366-7118	1/29-31
ICC/Portland EPA	MD-13	911 51503	
DON LOKEY TVA	TVA CEB 2A MUSCLE SHOALS, AL 35660	205-386-2035	29 JAN-
WAYNE KAISER EPA, Region 7 AIR BRANCH	726 MINNACON AVE KANSAS CITY, KS 66101	913 531-7663	1/29-30/9
Wm Sonntag Not Assn of Metals Finishers	1101 Conn. Ave NW # 700 DC 20036	202-857-1100	1/29-31/9
S. B. Peirce-Sandner Eastman Kodak Co	Holtec Environment Labs Rochester, NY 14652	716-584-6477	1/29-1/9
ROBERT C. COLEMAN AMERICAN PACKAGING CORP	GRAND ASHTON RD PHILA PA 19114	215-698-5408	1/29
Elizabeth A. Hilder EPA and others	Independence Mall West Philadelphia PA 19105	215-512-2545	1/29
DR Pannell ALLIED SIGNAL	P.O. Box 31 PETERSBURG, VA 23855	804-520-3388	1/29, 30/9
A-T Roy ALLIED SIGNAL			
Beth Keller ALLIED SIGNAL			
G.P. Edwards	Tetac Chemical Co. 3040 Post Oak Blvd. Houston, TX 77056	(713) 235-6400	1/29-1/31
ETL Crumley EPA	MD-13	541-5671	1

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BOB EHRHARDT GENERAL ELECTRIC	3135 EASTON TPK FAIRFIELD, CT 06431	203-373 3030	1/29 + 30
Bill Schott Kimire, Inc.	P.O. Box 570846 PERRINE FL 33257	305-233 4249	1/29-31
John Munnister British Petroleum	BP America Cleveland OH 44114	(216) 586 8434	1/29.
JEFF SHUMANER RADIAN CORP.	PO Box 13000 RTP NC 27709	919 541- 9100	1-29
JIM SERNE WESTON	WESTON WAY WEST. CHESTER, PA 19380	215 430-7209	1-29 + 30
JEFF PRATT KLEEN-RITE INC.	4444 GUSTINE AVE ST LOUIS MO.	314-353 1712	1/29-1/31
James H. Maysilles USEPA / OARPS	ESD / ISB, Mark Deerp B RTP, NC 27711	919- 541-3265	1/29-31
DREK A. NEWTON NAVAL ENERGY & ENVIRONMENTAL SUPPORT ACTIVITY	NEESA-111C PORT HVENENIE, CT 06043	805 982- 3903	1/29-31
Karen N.T. Olson Texas Air Control Bd	6330 Hwy 290 E Austin, Tex 78723	512- 451- 5711 x412	"
LASZLO TAKACS OCCIDENTAL CHEMICAL	360 RAINBOW BLVD NIAGARA FALLS, NY 14302	716 286-3103	"
Andra M. Lamb Savino Environmental Consultants	3733 National Drive Suite 120 Raleigh, NC 27612	919. 881- 0777	1/29 + 30
Charles K. Dorgay Bureau of Air Quality Ctl. S.C. Dept. Health & Env. Ctl.	P.O. Box 12544 Columbia, S.C. 29211	803- 734- 4500	1/29 - 1/31
Gene Wilson EPA / TSD / OARPS / EPA	MD-14	919-541 5544	1/29-31
Karl Meade Hale & Dorr	1455 Pennsylvania Avenue Washington, DC 20004	202 793- 0800	1/29-1/31

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James A. Litvin III Woodward-Lyde Consultants	3109 Poplarwood Ct Suite 120 Raleigh, NC 27604	919 850-9511	1/29/91
RANDALL K TAYLOR WOODWARD-LYDE Consultants	3109 Poplarwood Ct Suite 120 Raleigh, N.C. 27604	919 850-9511	1/29/91 1/30/91 1/31/91
M. Douglas Morris Griffith Micro Science	2973 Olympic Ind Dr Smyrna GA 30080	404 355-4485	1/29/91
William D. Curtin CURTIN & ASSOC INT'L	112-1 WASHINGTON PARK NEWTONVILLE, MA 02460	617 527 7757	1/29/91
Robert W. HERMANSON Amoco Corp	200 E Randolph St Chicago 60660	312 856-7995	1/29-31
Joe Freedman EPA - OGC	HQ LE-1325	202 382 7710	1/29-31
CHARLIE CARTER McGuire Woods Battle & Bothe	1627 I St., NW WASH, DC 20006	(202) 877-1733	1/29
Joe Horvath UNITI CARBIDE	39 Old Ridgebury Rd Danbury CT	203 794-5183	1/29-31
Tim Watkins EPA - OARPS	MD-13 Mutual Building RTP, NC	919 541-5217	1/29-1/30
Michael W Pucci AT&T	131 Morristown Road B2236 Basking Ridge, NJ 07000	908 204- 8209	1/29-1/31
THOMAS E MILLS POLAROID CORP	1265 MAIN ST. (WALTHAM, MA 02254)	(617) 684-6110	1/29-1/31
Ruthy Kortman EPA - OAR	(ANR-443) EPA / OAR / O PAR 4101 M St SW WASH DC 20460	(202) 475-8950	1/29-1/31
RICHARD SIGMAN Chemical Manufacturers Assoc.	2601 M Street, NW WASHINGTON, DC 20037	202 887-1313	1/29-1/31
EE McCarty EPA - OARPS	MD-14 RTP, NC. 27712	919 541-5546	1/29-1/31

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Ed Jukovich MASSCO	5911 Astor Circle Dearborn 48126	313 436-8680	1/29-30
E. GERE	CAN MFGS INSTITUTE 1605 MASSACHUSETTS UNION, DC		1/29-30
Wm. B. Mory-CIBO	6035 Burke Blvd Burke, VA 22015	(703) 250-9092	1/29
RICHARD H. VETTER	3030 CORNWALLIS DR. DURHAM NC 27709	(419) 240-7654	1/29
Diane Brando - 11/29	DC Box 1139 Harrisburg, PA 17106	217-435- 5120	1/29-30
JAMES F. JORILASKY HEALTH INDUSTRY MFGS ASSOC	1030 15th ST. N.W. #1100 WASHINGTON DC 20005	202-452- 8240	1/29, 30
BETH HASSETT - Sample EPA - OAQPS	USEPA, MD-13 RTP, NC 27711	919-541- 5314	
John Taladay Soap & Paper Products Co.	1050 Penn. Ave NW Suite 1100 Washington DC 20036	202-861- 1065	1/29
Clyde E. Riley Triangle Labs Inc	2306 Southern D. Durham, N.C. 27703	919- 544- 5729	1/29, 30 31
RONDA ROSS General Motors	30400 MONTROSE WARREN MI 48090	313 477/1420	1/29 & 30
Daniel P. Boyel Daniel P. Boyel & Co	242 Box 31513 Grosse Pointe MI 48238	313 827-0204	
D. J. DITEC - Air Quality Consultants	2000 BULL ST. COLUMBIA, SC 29201	803 734-4541	1/29-31
Dennis Wamsted Environment Week	627 National Press Bldg. Washington, DC 20045	202 662-9920	1/29-31
Army B. Vasu EPA - OAQPS	USEPA OAQPS (MD-13) RTP, NC 27711	(919) 541-0107	1/29

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

PLEASE PRINT

NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
KENNA Amos Roy F. Weston, Inc.	One Van de Graaff Dr. Burlington, MA 01803	617- 229-2050	1-29-91- 1-31-91
Mike Wilson Rust	100 Corporate Parkway Birmingham, AL 35222	205- 995-7230	1-29-91 -1-31-91
David Mankowski EPA		914 541-0437	1-29-91 1-31-91
Robert Rosensteel EPA	MD-13 RTP, NC	919 541-5208	11
Al Weho EPA	MD-13 RTP, NC	919 541-5623	1-29-91 ↓ 1-31-91
Carolyn O'Brien Jellinek, Schwartz, Connolly + Freeman	1015 15th St. NW Washington, DC 20005	202- 787-3282	1-29-30
James E. Gilchrist American Mining Congress	1920 N St NW ST0300 WASH DC 20036	202 861-2876	1-29-
Bob Manz Phillips Fibers Corp.	P.O. Box 66 Greenville, SC 29622	(803) 242- 6600	1-29-3
Bill Jameson NEEL	P.O. Box 12233 RTP, NC 27709	919- 541- 4096	1/24/91
M Dean High Pacific Environ. Services	13100 Brooks Dr Baldwin Park CA 91706	818 856-1400	1/24-31/
Donald A. Crane W. R. Grace & Co.	919 18th St. NW Washington, DC 20006	202 452-6703	1/29-31
Alan T. Roy Allied-Signal	P.O. Box 931 Hopkell, VA 23860	804 541-6155	1/24-30
Ted Palma Galsen Tech Services	4600 Marriott Drive Raleigh NC 27612	919 781-8209	1/29-31
Robt H. Oppenheimer Gravure Assoc. of America	90 Fifth Ave, 46 New York, NY 10011	212- 255-0070	1/29-30

RECORD OF ATTENDANCE
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JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Amanda Agnew Standards Development Branch EPA	RTP 27711 MD 13	919 541 5268 FIS 624 5268	1-29-91
Patricia R. Altman ALCOA	1501 ALCOA BLVD PITTSBURGH PA 15249	412-553 3805	1-29-1-31
Frances Sharples Oak Ridge National Lab	Bldg 1505 MS 6038 PO Box 2008 Oak Ridge, TN 37831-6038	615 576-0524 (FIS 626-0524)	1/29-1/30
Jerry Avery Michigan Air Quality Div.	Box 30028 Lansing, MI 48909	517 322 1336	1-29, 30, 31-91
Henry Rodriguez RINGIER AMERICA	ONE PIERCE PL ITABCA, IL 60143	(708) 285 6635	1/29/30/31
Dave Guinnup U.S. EPA	MD-14 RTP, NC 27711	919 541 5368	1/29
Mohsen Nazemi SCAQMD	9150 Flair Dr. El Monte, (CA 91731)	818 572 6145	1/29
Rick Copland US EPA	MD-13 RTP, NC 27711	(919) 541-5265	1/29-1/30
Melvin Keever BP	1776 I Street NW. Suite 1000 Washington, DC 20006	202 785-4888	1/29
Dorey Nell	U.S. EPA (MD-13) RTP, V.C. 27711	202 541 5368	all days
Tom WALSH DONALDSON CO	PO. Box 1299 CARLSBAD 92008	619-437-3400	1/29-31
Chuck Cohen LTPA	MD-13 RTP NC 27711	919 541 5268	1/29
THE KATZ LTC	B-545 PO Box 211 Kingsport, TN	423 221-3045	1/29-1/31
John J. Anderson EPA/HEAL	MD-13 RTP, NC 27711	919 541 5268	1/29

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Deborah Simpson NRDC	350 New York Ave NW Washington, DC 20001	(302) 285-7200	1/29 1/30
Steve Coppola DuPont	1009 Market St Wilmington DE	(302) 773-0149	1/29
Michelle Dubow EPA - OAQPS		541- 3803	1/29
WILLIAM E. FISHER INT'L. FIBERGLASS INST	12251 TECH ROAD SILVER SPRING, MD 20904	301 622-1900	1/30
Brenda Tellicorse RTI	PO Box 12194 RTP NC 27709	(919) 541-6116	1/30
Wayne B. Bolden Du Pont	655 Papermill Rd P.O. Box 6040 Newark, DE 19714-6040	(302) 366-2548	1/30
LARRY HECKLER ABBOTT LABS	1400 SHERIDAN NORTH CHICAGO, IL 60064	(708) 688-7758	(Please send) 1/30 + 31
Jack Farmer RTI	Research Triangle Park, NC	919 541-6909	1/29 1/30
LURT HOLMES HWAP	C.H. NC	919 376-3000	1/30
Allen Ammerman GRIFFITH MKRD SCI.	7775 QUINCY WILLOWBROOK, IL 60521	708 325- 6999	1/29-1/31
WILLIAM SEITZ Neighborhood Champions Assoc	116 EAST 27 STREET NEW YORK NY 10016	212 684-0945	1/30
HEATHER HOTMAN ARGONNE NAT'L LAB	5700 S CASS ARGONNE, IL 60439	708 972 6408	1/30
TOM COERVER LA DEQ	Box 44096 70804 Baton Rouge LA		1/30 +
Candace Samell EPA	MD-19 RTP, NC 27711	541-1064	1/30

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Donald W. Anderson Research Tri. Inst	RTP, NC 27709	919 541-5804	1/30/91
MILT MILAM DETREX	325 EMMETT Bowling Green, Ky	502 782-2411	1/30/91
M. Douglas Morris GMSI	2973 Olympic Ind Dr Smyrna Ga	404 355-4485	1/30/91
Brian Taranto Exxon Chemical	13501 Katy Frwy. Houston, Tx 77079	(713) 870-6117	11/30/91
MAck McCRAW Union Carbide	200 Liberty St Knoxville TN 37922	615 524-3626	1-30-91
DAVID LAZZO Midwest Research	Harrison Oaks Blvd Cary	919 677-0249	1-30-91
Susan Rasor Midwest Research	Harrison Oaks Cary	919 677-0249	1/30/91
Rima Dishakjian U.S. EPA	RTP, NC 27711	919 541 0443	1/30/91
R.H. Dickinson Westraeco Corp	299 Park Ave NY, NY 10171	212 638-5000	1/30/91
A. TURNBULL, P.E. TURNBULL ASSOC.	DURHAM, NC	919 490-5390	1/30/91
G C (CHRIS) PEDERSEN KIMBLE	Box 570546 MIAMI FL 33257	305 2334249	30/3/91
Jon Youngson Midwest Products Co.	Box 188 Owosso, MI 48867	(517) 723-3881	1/30/91
Jerry	EPA		
Chuck Marshall Jaca Corp	550 Pinetown Rd Ft. Washington PA 19034	215 643 5466	1/30,31

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Frank Chy	USEPA 27711 MD -14 Research & Park	5236	30 JAN 91
GARY O'DEA	CHEM. MAN. ASSOC. 2501 M. ST. WASH., DC. NW. 20037	202 887-1353	4/21/91, 1/30
ZACHARY S. COWAN, III	NAT'L ASBESTOS COUNCIL 1777 NE EXPRESSWAY, STE 550 ATLANTA, GA 30329	404 633-2622	21/29-31/91
DAVID F. MARTIN CM SERVICES, INC.	PLUMBING MFGS INSTITUTE 1655 N. PT MYER DRIVE #700 ARLINGTON, VA 22209	(703) 351-5295	1/30/91
Mohsen Noyan SCADA MD			1/30/91
Ronald Walten	PO Box 4335 Cary NC 27519		1/30/91
Barbara Runnels Panhandle Eastern Corp	1221 McKinney #2922 Houston, TX 77010	713 989- 2212	1/30/91
MREG Kimmel Duell	6050 N. Lotlioff Durand MI 48429	517 288 4785	1-30-91
David Ceamb Radcan Corporation	P.O. Box 13000 RTP, NC 27709	919 541-9100	1-30-91
Donald Johnston RTI	PO Box 12194 RTP, NC 27709	541-6706	1-30-91
Mike Loney RTI	PO Box 12194 RTP, NC 27709	919 541-6719	1/30/91
LOUIE M. MERRITT LIME I	2573 - LIME I INDUSTRIAL Spartanburg, SC 29582	803 355-4100	1-30-91
JONATHAN M. MERRITT LIME I	1730 N.E. LIME I INDUSTRIAL Spartanburg, SC 29582	803 355-4100	1-30-91
WIN TATTEL John Z. K. Co.	P.O. Box 70222 Tulsa, OK 74170	918 748-4440	31 JAN 91

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS 2973 (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
STANLEY KIRKILL GRIFIN MICRO SCIENCE	2973 OLYMPIC INDUSTRIAL BLVD SIMPLA GA	404 355-4495	Tues
DEAN HERNON POLYKEN TECHNOLOGY	2320 Bowling Green Rd Franklin, KY 42134	502 586-3261	Wed ONLY
EARL G. McCUNE NORTH CAROLINA DEM	PO BOX 27687 RALEIGH NC 27611-7677	919 733-3340	Wed only
LYNN Vendirello USEPA Office of Pollution Prevention	PM-222B 401 M St SW Washington DC 20460	202 202 382-2622	Wed ONLY
Robert Barker Midwest Research Institute	401 Harrison Oaks Blvd Suite 350 Cary NC 27513	919 677-0249	Wed only
Susan Shager MRI	"	"	"
Leslie Evans	USA EPA MD - 13	919 541 5410	
Bill Hohenstein Radian	P.O. B. 13000 RTP, NC 27709	541-9100	Wed. only.
Col. E. J. ...	655 Washington, D.C. 20005	202 850-5170	Wed.
BRUCE MOORE EPA/OACPS		541-5460	1/30
Darcy Campbell Radian Corp.	P.O. Box 13000 RTP, NC	541-9100	1/30
DAVID B. SUSSMAN OGDEN MARTIN SYSTEMS, INC.	5301 EISENHOWER AV ALEXANDRIA VA 22304	703 751-2523	1-31
ROSS E. HODGES JOHN ZINK CO.	P.O. Box 702220 TULSA, OK 74170	918 748-4942	1/31
IAN D. WANKER BP OIL	200 PUBLIC SQ. CLEVELAND OH 44114	216 586-8867	1/31

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
FRANCIS A. FERRARO WHEELABRATOR ENVIRONMENTAL SYSTEMS INC	LIBERTY LANE HAMPTON, NH 03842	603 929-3305	1/31/91
GERARD SNOW TRANSPORTATION INSTITUTE	5001 AOTH Way CAMP SPRINGS, MD 20746	301 423-3337	1/31/91
DAVID OWENS ALLIED MARINE IND.	PO BOX 717 NORFOLK, VA 23501	804 545-7301	1/31/91
H. Hootman AIR QUALITY UNIT LAB. MCDONALD-604-12	9700 - CANT.	707 221-1112	1/31/91
DAN MARSH Midwest Research Institute	Suite 350 405 Harrison Oaks Blvd Cary, NC	919-677- 0249	
Rebecca Nicholson MRI	same as above	11	1/31/91
David Kupella MRI	11	11	1/31/91
Maresa Williamson MRI	11	11	1/31/91
Allen Hammerman GRIFFITH MICRO SCIENCE	7775 QUINCY WILLOWBROOK, IL 60521 MINUTES OF MTG	708-325- 6999	1/31/91
SEAN T. CONNOR AMERICAN PETROLEUM INSTITUTE	1220 L STREET, NW WASHINGTON, DC 20005	202-682- 5194	1/31/91
AD. Marsh US COAST GUARD	8100 2ND ST SW WASH DC 20593	202-267- 0002	1/31/91
David S. Bendley Westinghouse R&D	2400 Ardmore Blvd Pittsburgh PA 15221	(412) 636-5300	1/31/91
James D. Kilgore EPA, AERL	RTP, NC 27711	919 541-2854	1/31/90
AL VERVAERT ENR/DOOPS	MD-13 RTP, NC 27711	919 541-5603	1/31/91

RECORD OF ATTENDANCE
NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE MEETING
JANUARY 29, 30, AND 31, 1991

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NAME AND AFFILIATION	BUSINESS ADDRESS (INCLUDE ZIP CODE)	TELEPHONE NUMBER	DATE(S) ATTENDED
Jack L. Linton	BP X 900 E. Benson Blvd Anchorage AK 99519	(907) 564-5741	1/30/91
Steve Levy USEPA - OSW	05-301 Washington, DC 20460	202-382-4745	1/31/91
WILLIAM R LUT HUIDE SHIPPING	PO BOX 13038 FORT LAUDERDALE FLORIDA 33442	305 523-2200	1/31/91
Mohsen Nazem SCARM	9150 Flandr El Monte, CA 91731	818 572 6145	1/31/91
Richard Anderson Wheelabrator	Liberty Lane Hampton NH 03842	603/ 929-3329	
JOHN PIRICH Hansmann Miller	1400 Mich Nat Tues LANSING, Mich	517 484-8072	1/31/91
Suzanne Shorata Midwest Research Inst	401 Harrison Oaks Blvd Cary NC 27513	919 671-0249	1/31/91
Tom McCurdy ASB	EPA	X 5650	1/31
Charles Brickley BP Exploration	PO BOX 146612 MBH-1 Anchorage Alaska 99519-6612	907 564-4664	1/31
Mary Jane Clark EPA	ESD (MD-13) RTP, NC 27711	919 541-5571	1/29-31/91

NATIONAL AIR POLLUTION CONTROL TECHNIQUES ADVISORY COMMITTEE

MINUTES OF MEETING

JANUARY 29-31, 1991

Assembled by:

Gene W. Smith
Gene W. Smith
Assistant to the Director
Emission Standards Division (MD-13)
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

I certify that, to the best of my knowledge, the foregoing minutes and attachments are complete and accurate.

James B. Weigold
James B. Weigold
Acting Chairperson
National Air Pollution Control
Techniques Advisory Committee

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OAQPS AIR
DOCKET CONTROL ROOM

CONTACT REPORT
Project No. 7723

A-88-03
RECEIVED MAY 8 1991

II E 385

David G. Hearne, MRI-NCO

Date of Contact: April 2, 1991

Date of Report: April 2, 1991

Company: Alabama Department of Agriculture
Address: 1445 Federal Drive
Montgomery, Alabama 36107

Telephone: (205) 242-2656

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Person(s) Contacted/Title(s):

- Mr. Guy W. Karr, Plant Pathologist
-
-

Contact Summary: (see attached pages as necessary)

According to Mr. Karr, Alabama's Department of Agriculture has not used its ethylene oxide beehive fumigator in several years, and has recently requested that the equipment be sold. In any event, they will not be using ethylene oxide for beehive fumigation in the foreseeable future.

When the equipment was in operation, the peak ethylene oxide use occurred during a two to three year period when the fumigator was used approximately 40 times each year. Mr. Karr could not recall the capacity of the fumigator.

CONFIRMATION	<i>PK</i>
<i>Guy W. Karr</i>	<i>5/2/91</i>
RESPONSE	
WRITTEN <input checked="" type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	

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CONTACT REPORTProject No. 7723OAQPS AIR
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David G. Hearne, MRI-NCO

Date of Contact: April 3, 1991

Date of Report: April 3, 1991

Company: N.C. Department of Agriculture
Address: Pesticides and Plant Protection Division
Blue Ridge Road Office Center
Raleigh, North Carolina 27607

Telephone: (919) 733-3610

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Person(s) Contacted/Title(s):

- Mr. Logan Williams
-
-

Contact Summary: (see attached pages as necessary)

According to Mr. Williams, the beehives fumigated by the Department comprise a very small industry. Therefore, the amount of ethylene oxide used is very small. He estimated that four (six at the most) seventy-pound cylinders of ethylene oxide were used each year for these fumigations.

From this information, the estimated maximum annual ethylene oxide use is 420 pounds.

CONFIRMATION
RESPONSE
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

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CONTACT REPORT
Project No. 7723OAGPS AIR
DOCKET CONTROL ROOM

David G. Hearne, MRI-NCO

Date of Contact: April 4, 1991

Date of Report: April 4, 1991

Company: Tennessee Department of Agriculture
Address: Ellington Agricultural Center
Nashville, Tennessee 37204

Telephone: (615) 360-0130

Contacted by:

Telephone (X)

Visit at MRI ()

Visit There ()

Person(s) Contacted/Title(s):

- Sylvester Davis, Director
- Thomas Hart
-

Contact Summary: (see attached pages as necessary)

Mr. Davis stated that the overall ethylene oxide use for beehive fumigations had decreased in past years. He routed my call to Mr. Hart.

Mr. Hart reiterated that the number of requests for beehive fumigations had decreased sharply. The Tennessee Department of Agriculture uses a carboxide mixture of 10% ethylene oxide for their beehive fumigators. He estimated that between 10 and 12 75-pound tanks of this ethylene oxide mixture were used each year (total ethylene oxide use: 90 lbs/year).

CONFIRMATION
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input checked="" type="checkbox"/>

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CONFIRMATION
DOCKET CONTROL ROOM
RESPONSE
DAVID G. HEARNE
MRI-NCO
NONE ☐

Rec'd

June 5, 1991

A-88-03

II E 388

CONTACT REPORT

Project No. 7723

David G. Hearne, MRI-NCO

Date of Contact: May 20, 1991

Date of Report: May 20, 1991

Company: Health Industry Manufacturers Association

Address: 1030 15th Street, N.W.
Washington, DC 20005-1598

Contacted by:
Telephone (X)
Visit at MRI (
Visit There (

Telephone: (202) 452-8240

Fax: (202) 289-1978

Person(s) Contacted/Title(s):

Vice President, Membership Development and Service
- James F. Jorkasky, ~~Director, Manufacturing and Quality Programs~~

Contact Summary: (see attached pages as necessary)

Mr. Jorkasky was contacted regarding any changes in the numbers of commercial sterilization facilities, and the potential for future changes. He noted that the most recent "hard data" regarding the number of facilities were presented in his testimony at the May, 1988 NAPCTAC meeting. He added that continuing anecdotal information he has indicates that the number of sterilization facilities is decreasing due to ~~pressure from states (in the form of new regulation on ethylene oxide use)~~. This decrease in the number of facilities is being offset by an increase in the size (capacity) of larger contract sterilization facilities, ~~resulting in approximately the same nationwide ethylene oxide amount use.~~

facilities closing or consolidating due to continuing and new regulatory requirements (e.g. state ETO EMISSIONS control requirement).

(i.e. fewer but larger sites with state-of-the-art worker and emissions control equipment).

Page 1 of 1

OK per
JF
5/31/91

Note: Contact at HIMA should be Barry Page, Director
Environmental and Occupational Programs

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CONTACT REPORT

Project No. 7723

OAQPS AIR
DOCKET CONTROL ROOM

David G. Hearne, MRI-NCO

Date of Contact: May 31, 1991

Date of Report: June 10, 1991

Company: California Air Resources Board
Address: Toxic Air Contaminant Control Branch
P.O. Box 2815
Sacramento, California 95812

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 916-322-6023

Person(s) Contacted/Title(s):

- Cliff Popejoy
-
-

Contact Summary: (see attached pages as necessary)

Mr. Popejoy was contacted to check on the availability of the CARB's test methods for EO in commercial sterilizers, and to see if data were available on emissions from sterilizers and aeration rooms.

Mr. Popejoy stated that the test methodology used for ethylene oxide were essentially the same as the 1988 methodology. He added that although the methodology had not changed, the ethylene oxide commercial sterilization regulation as adopted did require specific conditions to be met in order to use the test methods (number 431).

Additionally, Mr Popejoy stated that the 90-10 percent split between emission from sterilizers and aeration rooms was more a theoretical determination than the result of actual data.

He is sending copies of the regulation, test methods, and 90-10 split information to me. He asked that we comment on any aspects of the information, especially the 90-10 split determination. He also expressed an interest in receiving any future mailings regarding ethylene oxide regulation.

CONFIRMATION
RESPONSE
WRITTEN <input type="checkbox"/> VERBAL <input type="checkbox"/> NONE <input checked="" type="checkbox"/>

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DOCKET CONTROL ROOM

CONTACT REPORT
Project No. 7723

A-88-03

II E 390

David G. Hearne, MRI-NCO

Date of Contact: June 14, 1991

Date of Report: June 14, 1991

Company: California Air Resources Board
Address: Toxic Air Contaminant Control Branch
P.O. Box 2815
Sacramento, California 95182

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 916-322-6023

Person(s) Contacted/Title(s):

- **Cliff Popejoy**

-

-

Contact Summary: (see attached pages as necessary)

Mr. Popejoy was contacted to follow-up on information provided in a meeting between EPA-OAQPS staff members and CARB representatives. Specifically, Mr. Popejoy was asked if CARB had conducted any emissions tests during the development of their ethylene oxide regulations.

Mr. Popejoy stated that CARB had not carried out any emissions tests for the ethylene oxide regulations. The only information used to develop the regulation was that referenced in the "Staff Report on Ethylene Oxide" and the "Technical Support Document" [both of which he had provided to MRI in response to a previous request]. He stated that he felt that EPA would be better served by obtaining any of these references from the original sources. He added, however, that if EPA encountered any difficulties in obtaining these references, he could arrange for copies to be provided from their file copies.

CONFIRMATION _____
RESPONSE _____
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input checked="" type="checkbox"/>

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AUG 25 1997

OAQPS AIR
DOCKET CONTROL ROOM

A-88-03

II E 391

MEMORANDUM

To: Project Files

From: David Hearne

Date: June 17, 1991

Subject: Contact with EPA and Professional Contract Sterilization, Massachusetts.

On June 14, 1991, David Markwordt called me via conference call with Lori Lay of EML to inform MRI that he had received a call from Mr. Jerry Cranston of Professional Contract Sterilization, a new medical equipment ethylene oxide sterilization facility located in Massachusetts. According to David, Mr. Cranston had contacted him to see if the EPA had any testing protocols for control devices attached to EO sterilizers (Mr. Cranston noted that his facility had a Damas scrubber). David responded that EPA was interested in assisting Professional Contract Sterilization in their testing operations in an advisory capacity, and that he would be contacting Mr. Cranston soon to obtain additional information.

Following this conversation, David initiated a conference call to Mr. Cranston. I invited Val deOlloqui to sit in on the conversation because of his involvement with previous EO tests and site visits. Mr. Cranston stated that professional Contract Sterilization was a new sterilization facility that would sterilize medical products only using 100% ethylene oxide. They were interested in obtaining any assistance possible from EPA in regards to testing and sampling protocols. David and Lori responded that these protocols were under development by EML, but that they should be completed in draft form soon (i.e., hopefully, the week of June 17, 1991). David explained that EPA did not conduct the tests but would, if invited, monitor any testing and provide assistance in developing test protocols. David explained the status of the ethylene oxide regulation development project, and suggested to Mr. Cranston that he write a letter to EPA announcing that his facility intends to do a test. Mr. Cranston also asked if anyone at EPA knew an approximate cost for testing. Lori stated that her contractor, Radian, had given her an estimate of \$50,000 for testing at a facility in Florida (Lori also explained that this estimate was for a Federal contract, and that the costs for tests at a different site --ideally by a testing contractor located nearby--would vary quite a bit). Mr. Cranston noted that in preliminary conversations with a New Jersey testing firm (Conroe? I believe was the name used), an estimate of \$7,000 had been used. Mr. Cranston added that his facility would like to do this testing in

July (he realized that this was an ambitious deadline, August would probably be more likely), and that said test would likely last for two days. Mr. Cranston stated that this facility manifolded emissions from "all over the plant" to a two-stage scrubber.

Mr. Cranston stated that he would provide schematic diagrams of the sterilization operation to David and Lori as soon as possible. Lori stated that she would provide a copy of the draft testing protocol to Mr. Cranston as soon as they were available. Mr. Cranston may be reached as follows:

voice	508-880-6915
fax	508-880-6916.

Following this conversation, I advised Roy that the level of activity under this work assignment may change if the Agency decides to assist in this test.

cc: D. Markwordt (EPA)
E. Friedman (MRI)

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A-88-03
II E 392

CONTACT REPORT
Project No. 7723

David G. Hearne, MRI-NCO

Date of Contact: July 23, 1991

Date of Report: July 24, 1991

Company: California Air Resources Board
Address: Legal Section
P.O. Box 2815
Sacramento, California 95812

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 916-322-2884

Person Contacted:

Title:

- Mr. Tom Jennings

Attorney

Contact Summary: (see attached pages as necessary)

Mr. Jennings was contacted in regards to a potential request for data from the CARB ETO data base.

Speaking in general, Mr. Jennings stated that Confidential Business Information had been supplied to U.S. EPA and their contractors in the past when EPA had agreed to regard the materials as confidential. He added that this method would be less complicated than a Public Records Act Request, and would probably allow us to get the information faster. I provided Mr. Jennings with the data elements that we would need from the ETO data base (including: company name, annual ethylene oxide use, what control devices --if any-- were in use at a given facility, estimated ethylene oxide emissions, and the Standard Industrial Classification code for the facility. He stated that he would have someone call me regarding this request (he would be on vacation shortly).

CONFIRMATION
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input checked="" type="checkbox"/>

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AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT REPORT
Project No. **7723**

A-88-03

CONFIRMATION	II E 393
RESPONSE	
WRITTEN <input type="checkbox"/>	
VERBAL <input type="checkbox"/>	
NONE <input type="checkbox"/>	
Date of Contact:	July 23, 1991
Date of Report:	July 24, 1991

David G. Hearne, MRI-NCO

Company: California Air Resources Board
Address: Toxic Air Contaminant Control Branch
P.O. Box 2815
Sacramento, California 95812

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 916-327-5636

Person Contacted:

- Ms. Carol McLaughlin

Title:

Assoc. Air Pollution Specialist

Contact Summary: (see attached pages as necessary)

Ms. McLaughlin was contacted in regards to the data base developed by CARB containing information on facilities using ethylene oxide in the State.

concerns
Ms. McLaughlin stated that these data were collected from several surveys of industries in California selected from lists of facilities maintained by other State and county agencies (~~Public Services~~ Department, Health Services Department, county records). Hospitals were surveyed using a questionnaire requiring extensive information, while some non-hospital ethylene oxide users received a more simple questionnaire ("Do you use ethylene oxide, Yes or No"). The data collected from these questionnaires were developed into the CARB ETO data base. *and common sterilize and processing*

Ms. McLaughlin stated that some of the ~~emissions~~ data contained in the data base are based on estimates of ethylene oxide use rather than on actual emissions data. However, she stated that for facilities on which control devices were known to be in place, appropriate emissions reductions were considered in the determination of emissions from these facilities.

Ms. McLaughlin stated that because some of the data in this data base had been claimed as confidential, any requests for the data should be made in the form of a Public Records Act Request of her Branch's Legal Section. Ms. McLaughlin added that these data have been made available to U.S. EPA (and their contractors) in the past on an "as is" basis provided that EPA confirms the CBI nature of the data. She provided the phone number for the Legal Section: 916-322-2884; their address is the same as hers.

1

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A-88-03

II E 394

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CONTACT REPORT

Project No. 7723

David G. Hearne, MRI-NCO

Date of Contact: July 24, 1991

Date of Report: July 24, 1991

Company: California Air Resources Board
Address: Legal Section
P.O. Box 2815
Sacramento, California 95812

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 916-322-2884

Person Contacted:

- Ms. Leslie Krinsk

Title:

Senior Staff Counsel

Contact Summary: (see attached pages as necessary)

Ms. Krinsk called me in response to my conversation with Mr. Tom Jennings of CARB's Legal Section regarding our obtaining data from the CARB ETO data base.

Ms. Krinsk stated that she was coordinating our request for the ethylene oxide data base information. According to her, the Toxic Air Contaminant Control Branch, as well as the Legal Section were reviewing the data I had requested to see if any of them were Confidential Business Information. When this determination had been made, she stated that the non-confidential data would be sent to me. If we decided to request the CBI data, she suggested that our EPA project lead contact her for the necessary coordination.

Ms. Krinsk added that I should feel free to contact her with any questions or problems with this matter.

CONFIRMATION
<i>Leslie M. Krinsk 8/18/91</i>
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input type="checkbox"/>

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DOCKET CONTROL ROOM

CONTACT REPORT
Project No. 7723

A-88-03
II E 395
FILE COPY

David G. Hearne, MRI-NCO

Date of Contact: January 30, 1992

Date of Report: January 30, 1992

Company: Professional Medical Products
Address: Seamless Division
1909 NE 25th Avenue
Ocala, FL 32670

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 904-732-0600

Person Contacted:

- Mr. Tony Rierson

Title:

Engineering Manager

Contact Summary: (see attached pages as necessary)

Mr. Rierson was contacted regarding the continued operation of the ethylene oxide sterilizer at Professional Medical Products in Ocala, Florida; specifically, the aeration room facilities at this operation. During the last contact made with this facility Mr. Rierson and/or Mr. Lee Cutright (Director of Quality and Regular Affairs) indicated that their facility might discontinue on-site sterilization/aeration operations and may opt for contract sterilization.

During our conversation of January 30, 1992, Mr. Rierson confirmed that the Ocala, Florida facility had discontinued all use of ethylene oxide for sterilization purposes.

CONFIRMATION
<i>Anthony N. Rierson</i> 2/7/92
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input type="checkbox"/>

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

A-88-03

II E 396

CONTACT REPORT - MRI PROJECT NO. 7095-23

From: Peggy Redmond
Date of Contact: February 26, 1992
Contacted by: Telephone
Telephone Number: (708) 654-5183
Person(s) Contacted/Title(s):
Mr. Allen Ammerman/Environmental Manager

Company/Agency: Griffith Micro Science
Suite 120
200 S. Frontage Drive
Burr Ridge, Illinois 60521

Mr. Ammerman was contacted regarding control devices on the aeration rooms of commercial sterilizers using ethylene oxide.

Mr. Ammerman said that their New Mexico facility has a catalytic oxidation unit that controls emissions on the hot cellTM (the aeration room) to 20,000 cubic feet per minute (CFM). This configuration has been permitted by the State and running for the last 9 months. The catalytic oxidation unit runs continually and has achieved 99.66 percent control. Typically, inlet concentrations of ethylene oxide range from 19 to 30 ppm and the outlet concentrations range from .1 to .2 ppm. There are plans to retrofit the company's Los Angeles facility's aeration room with the same type of technology. It currently uses acid scrubbers. Two catalytic oxidizers at 15,000 CFM will be installed. The New Mexico facility has ~~6 aeration chambers~~ totalling approximately 6,000 cubic feet. Purchases for 1991 of 100% ethylene oxide for the Los Angeles facilities were: 49th Street - 126,800 pounds and for 50th Street - 162,400 pounds. The New Mexico facility purchased ~~556,800~~ pounds of 100% ethylene oxide in 1991.

267,600

The New Mexico ^{*} facility has 3 aeration cell associated with each sterilization retort.
May 11, 1992 Allen Ammerman
Confirmed (Date)



**FACSIMILE
CORRESPONDENCE**

TO: MS. PEGGY REDMOND

MRI

FAX NO: 919/ 677-0065 EXT. 5377

BUSINESS PHONE: 919/ 677-0249

FROM: ALLEN AMMERMAN

FAX NO: 708/ 654-5181

DATE: May 11, 1992

BUSINESS PHONE: 708/654-5183

LOCATION: Suite 120
200 S. Frontage Rd.
Burr Ridge, IL 60521

TOTAL NUMBER OF PAGES (INCLUDING COVER PAGE): 2

RE: MRI PROJECT NO. 7095-23

ATTACHED IS THE CORRECTION OF YOUR REPORT SENT TO ME.

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CONTACT REPORT
Project No. 7795-23

A-88-03

II E 397

OAQPS AIR
DOCKET CONTROL ROOM

David G. Hearne, MRI-NCO

Date of Contact: March 16, 1992

Date of Report: March 17, 1992

Company: Donaldson Company, Inc.
Address: P.O. Box 1299
Minneapolis, MN 55440-1299

fax: 612-887-3612

Telephone: 612-887-3131

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Person Contacted:

- Mr. Fred Schmidt

Title:

Sales Engineer / Acct. Mgr.

Contact Summary: (see attached pages as necessary)

Per a request by David Markwordt (EPA:CPB), Mr. Schmidt was contacted regarding the availability of emissions reduction data for the catalytic oxidation control devices sold by Donaldson Company. Specifically, information was requested on catalytic oxidation units installed on aeration chambers.

Mr. Schmidt stated that he was in the process of drafting a memorandum containing this information. He hopes to send this memorandum by the end of this week (i.e., March 20). The memorandum will be addressed to either David Markwordt or myself.

CONFIRMATION *3/20/92*
Fred Schmidt
RESPONSE
WRITTEN ☐
VERBAL ☐
NONE ☒

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OAQPS AIR
DOCKET CONTROL ROOM

A-88-03

II E 398

CONTACT REPORT - MRI PROJECT NO. 7095-23

From: Peggy Redmond
Date of Contact: March 26, 1992
Contacted by: Telephone
Telephone Number: (612) 574-3288
Person(s) Contacted/Title(s):
Mr. Phil Cogdill - Supervisor of Sterilizer Services

Company/Agency: Medtronic, Inc.
7000 Central Avenue, N.E.
Minneapolis, Minnesota 55432
Mail Stop B259

Mr. Cogdill was contacted regarding control devices on the aeration rooms of commercial sterilizers using ethylene oxide.

Mr. ^{Cogdill}Adams said that Medtronic currently has ^{a 1500 CFM}an Abator™ catalytic oxidation unit that controls emissions from 3 small sterilizers and the aeration room. The aeration room is about 1000 cubic feet with a separate air handler. Test data are available from Donaldson Co. since they conducted the testing for this unit. Mr. Cogdill said that he would have no problem with Donaldson releasing that data to us. He was to call Fred Schmidt of Donaldson later in the afternoon and would pass this information on to him.

→ exhaust is controlled by the Abator.

According to Mr. Cogdill, the State of Minnesota has no regulations for fugitive emissions. Annual ethylene oxide usage at the facility is approximately 25,000 pounds of 12/88 mixture.

Phil Cogdill
Confirmed (Date)

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AUG 26 1997

A-88-03

II E 399

DOCKET CONTROL ROOM
OAGPS AIR CONTACT REPORT - MRI PROJECT NO. 7095-23

From: Peggy Redmond

Date of Contact: March 30, 1992

Contacted by: Telephone

Telephone Number: (813) 887-2351

Person(s) Contacted/Title(s):

MS. Gerry O'Dell - Manager of Sterilizer Services

Company/Agency: Critikon, ^{Inc.} Johnson and Johnson Company)
P.O. Box 31800
Tampa, Florida 33631-3800

Ms. O'Dell was contacted regarding control devices on the aeration rooms of commercial sterilizers using ethylene oxide.

Ms. O'Dell said that her facility currently has an Abator™ catalytic oxidation unit that controls emissions from a small sterilizer and aeration chamber (approximately 50 cubic feet). The facility uses sterilization for research and development work. The main production facility in Connecticut does not control aeration room emissions; they still use a large warehouse room for off-gassing.

Ms. O'Dell provided additional information contacts: 1) Mr. Pat Adams of Isomedix and; 2) Mr. Jim Gibson of Johnson and Johnson Medical (telephone (813) 852-6165).

Gerry A. O'Dell 4/6/92
Confirmed (Date)



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AUG 28 1997

OAQPS AIR
DOCKET CONTROL ROOM

MAILED 88-032
II E 400 RESEARCH INSTITUTE

Suite 350

Harrison Oaks Boulevard

Cary, North Carolina 27513-2412

Telephone (919) 677-0249

FAX (919) 677-0065

April 2, 1992

Mr. Mike Au
Director, Regulatory Quality Assurance
Medical Design Concepts
43225 Business Park Drive
Temecula, California 92590

Dear Mr. Au:

Thank you for the information you provided in your telephone conversations with me on February 19, 1992, and March 31, 1992. Enclosed are two copies of the contact report summarizing the information discussed.

To ensure the accuracy of data that may be used in the development of national emission standards for commercial sterilizers and fumigators using ethylene oxide, the U. S. Environmental Protection Agency requires that all information contained in telephone contact reports must be confirmed. Please review the enclosed report and make any changes you believe are necessary to make the report accurate and complete. Please sign and date one copy and return it to me. Retain the other copy for your records. A final version of the report, incorporating any changes you request, will be placed in the files of support information for this project. If we have not received a response from you by April 30, 1992, the report will be considered final and will be placed in the project files which will be made available to the public.

Thank you for reviewing this report. If you have any questions, please call me at (919) 677-0249, extension 5377.

Sincerely,

Peggy Redmond

Peggy Redmond
Environmental Scientist

Enclosures

CONTACT REPORT - MRI PROJECT NO. 7095-23

From: Peggy Redmond

Date of Contact: February 19, 1992 and March 31, 1992

Contacted by: Telephone

Telephone Number: (714) 699-4400

Person(s) Contacted/Title(s):

Mr. Mike Au - Director, Regulatory Quality Assurance

Company/Agency: Medical Design Concepts
43225 Business Park Drive
Temecula, California 92590

Mr. Au was contacted regarding control devices on the aeration rooms of commercial sterilizers using ethylene oxide.

Mr. Au said his facility uses a hot cell (a smaller heated aeration chamber) instead of a conventional warehouse-type room for aeration after sterilization. Under California requirements, the facility must control fugitive emissions such as those from the aeration process. If the OSHA requirement for ethylene oxide can be met, then emissions are controlled under the South Coast Management District Regulation 1405. Currently the control device for the hot cell is a catalytic oxidizer that is expected to be tested and certified by California for permit purposes in March 1992. An emissions reduction of greater than 99.5 percent will be required for the device.

Mr. Au was also contacted on March 31, 1992, with some follow up questions regarding annual ethylene oxide use and the availability of test data. Mr. Au said their annual use was approximately 20,000 pounds of 12/88 ethylene oxide mixture. Their facility is still undergoing a review of their permit testing protocol by an independent laboratory in preparation for a permit. Until the facility is permitted and the test data then becomes available to the public, Mr. Au does not wish to disclose any of these data.

Confirmed (Date)

CONFIRMATION	None as of 7/27/92
RESPONSE	
WRITTEN	<input type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input checked="" type="checkbox"/>

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DOCKET CONTROL ROOM

MAILED 6-2-92
A-88-03

II E 401

ST RESEARCH INSTITUTE

Suite 350

401 Harrison Oaks Boulevard

Jary, North Carolina 27513-2412

Telephone (919) 677-0249

FAX (919) 677-0065

April 2, 1992

Mr. Wayne Roger
Senior Principal Engineer
IVAC
Mail Drop 11/2
10300 Campus Point Drive
San Diego, California 92121-1579

Dear Mr. Roger:

Thank you for the information you provided in your telephone conversations with me on February 25, 1992, and March 31, 1992. Enclosed are two copies of the contact report summarizing the information discussed.

To ensure the accuracy of data that may be used in the development of national emission standards for commercial sterilizers and fumigators using ethylene oxide, the U. S. Environmental Protection Agency requires that all information contained in telephone contact reports must be confirmed. Please review the enclosed report and make any changes you believe are necessary to make the report accurate and complete. Please sign and date one copy and return it to me. Retain the other copy for your records. A final version of the report, incorporating any changes you request, will be placed in the files of support information for this project. If we have not received a response from you by April 30, 1992, the report will be considered final and will be placed in the project files which will be made available to the public.

Thank you for reviewing this report. If you have any questions, please call me at (919) 677-0249, extension 5377.

Sincerely,

Peggy Redmond

Peggy Redmond
Environmental Scientist

Enclosures

CONTACT REPORT - MRI PROJECT NO. 7095-23

From: Peggy Redmond
Date of Contact: February 25, 1992, and March 31, 1992
Contacted by: Telephone
Telephone Number: (619) 458-7000
Person(s) Contacted/Title(s):
Mr. Wayne Roger/Senior Principal Engineer

Company/Agency: IVAC
10300 Campus Point Drive
Mail Drop 11/2
San Diego, California 92121-1579

Mr. Roger was contacted regarding control devices on the aeration rooms of commercial sterilizers using ethylene oxide.

Mr. Roger said both their facilities (in North Carolina and California) used closed loop sterilization systems. An acid scrubber was used to control emissions from the sterilizer in conjunction with a catalytic oxidation unit. The sterilized material is then placed in a "hot cell" or aeration chamber (approximately 2,000 cubic feet) with heat and ventilation controls. Emissions from this aeration chamber are controlled with a catalytic oxidation unit. This configuration was the result of modelling done based on the human risk numbers for each State's permit requirements. Ethylene oxide usage was reduced from 26,000 lbs to 11,000 lbs last year with a change in mixture (from 12/88 to 10/90). However, Mr. Roger does expect usage to increase some this year because their California facility has closed and all that capacity is now shifted to the North Carolina facility. The control efficiency of the catalytic oxidation unit is approximately 99.9 percent.

Bag sampling has been done on the catalytic oxidation unit. However, when asked if the monitoring data could be assessed by EPA, Mr. Roger stated he would like to reevaluate the data first to see whether they would meet EPA requirements.

CONFIRMATION	none as of
	7/27/92 -PR
RESPONSE	
WRITTEN	<input type="checkbox"/>
VERBAL	<input checked="" type="checkbox"/>
NONE	<input type="checkbox"/>

Mr. Roger was contacted again on March 31, 1992, to clarify some questions on ethylene oxide usage and whether test data were available. Mr. Roger would still like to reevaluate the test data and did clarify the ethylene oxide usage (corrections reflected in the paragraphs above).

Confirmed (Date) _____

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A-88-033 ✓

AUG 26 1997

II E 402

OAQPS AIR
DOCKET CONTROL ROOM

CONTACT REPORT - MRI PROJECT NO. 7095-23

From: Peggy Redmond
Date of Contact: February 28, 1992 and March 31, 1992
Contacted by: Telephone
Telephone Number: (901) 757-4030
Person(s) Contacted/Title(s):
Mr. Pat Adams - Vice President, Ethylene Oxide Operations

Company/Agency: Isomedix
Suite 10
1922 Exeter Road
Germantown, Tennessee 38138

Mr. Adams was contacted regarding control devices on the aeration rooms of commercial sterilizers using ethylene oxide.

Mr. Adams said that Isomedix currently has 2 operating facilities, and 1 under construction. Next year, 1 to 2 new facilities are planned. Their sterilizers use a thermal oxidation control device that provides a 99.993 percent control. While this unit has a higher capital cost, it is offset by a higher efficiency and lower waste disposal costs. The sterilizer is adjacent to the aeration chamber (or "hot cell," approximately 17 feet high and 12 feet wide). Product is unloaded from the sterilizer into the hot cell by a conveyor belt and monitored by camera. This is done to minimize human exposure. Emissions from the hot cell are controlled with a catalytic oxidation unit that achieves better than 99 percent control. They also have developed a catastrophic release control system for their ethylene oxide storage rooms in the event of an explosion. All ambient intakes for this room exhaust through a sieve developed by Advanced Air Technologies. This sieve can handle an accidental release of up to 300 pounds of ethylene oxide.

Mr. Adams also extended an invitation to tour their Spartanburg facility to view this system.

Mr. Adams was also contacted on March 31, 1992, for some follow up questions regarding annual ethylene oxide use and the availability of test data on these control devices. Mr. Adams said that he would send the ethylene oxide use data separately since he had to pull that information from the files. They use

should need significant
source leak such as a broken
drum valve or cracked gas line

See
ATTACHED
Memo
P. Adams
4/13/92

To all in lab

pure ethylene oxide in the sterilizers. Mr. Adams also said he would send test data for the flare control device. Any test data on the catalytic oxidation unit would be available from Donaldson since they performed the initial test. He did not have the opportunity to observe the test and cannot enlighten us on any of the methodology used.


Confirmed (Date) 4/13/92



April 13, 1992

Peggy Redmond
Environmental Scientist
MIDWEST RESEARCH INSTITUTE
401 Harrison Oaks Blvd. Suite 350
Cary, N.C., 27513-2412

Dear Ms. Redmond:

I am returning your copy of the contact report you generated from our 2/28/92 and 3/31/92 telephone conversations. In reviewing the report I found one minor error. In the second paragraph you mentioned the Isomedix emission control system utilized in the EtO storage rooms. Your report describes this system correctly as a catastrophic release control unit but it states that it is for use in conjunction with an "EXPLOSION". This control system is not designed for operation in the event of an explosion. Its purpose is to capture and contain EtO resulting from a significant source leak such as; a broken drum valve or a cracked gas line. The control system is designed to prevent a large release of EtO into the atmosphere and to quickly capture EtO to minimize the potential of any explosion.

Hopefully, this clarifies the design and use of the Isomedix EtO storage room emission control system. If additional data is required, please contact me.

Also enclosed is data from our testing of the thermal oxidation system in El Paso, Texas. This information includes the test methodology and a summary of the results.

As to the question of Isomedix' EtO usage in 1991:

Spartanburg, S.C. usage was 104,400 lbs.
El Paso, Texas usage was 220,800 lbs.

(note: 100%
EtO PL)

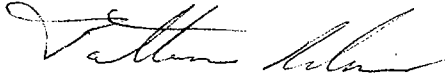
As we discussed, El Paso and Spartanburg significantly increased their capacity in the fourth quarter of 1991 and will use higher volumes of EtO in the future.

ISOMEDIX INC.

MRI Con't
Page 2

We thank you for your assistance in correcting these items and look forward to working with you and your staff in the future.

Sincerely,

A handwritten signature in cursive script, appearing to read "Patterson Adams".

Patterson Adams
Vice-President
EtO Operations

ISOMEDIX INC.

4

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OAQPS AIR
DOCKET CONTROL ROOM

CONTACT REPORT
Project No. 7095-23

A-88-03
FILE COPY

II E 403

David G. Hearne, MRI-NCO

Date of Contact: 08/07/92

Date of Report: 08/07/92

Company: Donaldson Company, Inc.
Address: P.O. Box 1299
Minneapolis, MN 55440-1299

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 612-887-3140

Fax: 612-887-3612

Person Contacted:

Title:

- Mr. Frederick Schmidt

Sales Engineer/Account Manager

Frederick W. Schmidt 8/14/92

Contact Summary: (see attached pages as necessary)

Mr. Schmidt was contacted regarding a letter from him to me dated March 24, 1992. Specifically, I was interested in the time period over which facilities referenced in this letter had installed control devices on emissions from their aeration room vents.

technology Mr. Schmidt stated that the facilities referenced had installed controls on their aeration room emissions over the past seven years. He clarified this statement by saying that the control technology has been available for the past seven years, but that prior to Donaldson's purchase of the (approximately four years ago), the sterilization industry did not make significant use of it. Most of the facilities referenced on the March 24 letter had installed the Donaldson control devices within the past two years, and many of these had installed the devices in the past six months.

Mr. Schmidt also inquired as to the status of EPA's NESHAP development effort for this source category. I referred him to David Markwordt of EPA:CPB to whom he had previously talked. I confirmed that his name was included on the list for any public mailing of information regarding this project.

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AUG 23 1997

OAQPS AIR
DOCKET CONTROL ROOM

A-88-03
II E 404

CONTACT REPORT
Project No. 6501-53-52

David G. Hearne, MRI-NCO

Date of Contact: October 19, 1992

Date of Report: October 20, 1992

Company: Chemrox, Inc.
Address: 217 Long Hill Crossroads
Shelton, CT 06484

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 203-926-9081

Fax: 203-926-9334

Person Contacted:

Title:

- Mr. Pankaj Desai

President

Contact Summary: (see attached pages as necessary)

Mr. Desai was contacted to determine the current state of installed emissions control equipment dedicated to aeration rooms/chambers at ethylene oxide sterilization/fumigation operations. Specifically, he was asked for any information regarding facilities to whom Chemrox had sold control devices specifically for aeration room vents.

Mr. Desai stated that the control units sold by Chemrox, Inc. were designed to control emissions streams from both the sterilizer vent and the aeration room vent. The emissions from the two vents are treated separately in two separate absorption towers which are controlled by a single control panel. The absorption towers utilize other common elements including a single outlet vent. According to Mr. Desai, approximately five of these control units have been installed.

Mr. Desai inquired about the development of the Ethylene Oxide Commercial Sterilization National Emissions Standard for Hazardous Air Pollutants (NESHAP), and was referred to Mr. David Markwordt (EPA:OAQPS: Chemicals and Petroleum Branch) for additional information.

CONFIRMATION <i>phone call</i>
<i>from Mr. Desai: 8/20/92</i>
RESPONSE _____
WRITTEN <input type="checkbox"/>
VERBAL <input checked="" type="checkbox"/>
NONE <input type="checkbox"/>

RECEIVED

AUG 26 1997

OAQPS AIR
DOCKET CONTROL ROOM

A-88-03

II E 405

CONTACT REPORT
Project No. 6501-53-52

David G. Hearne, MRI-NCO

Date of Contact: October 21, 1992

Date of Report: October 21, 1992

Company: Damas Corporation
Address: 8 Romanelli Avenue
South Hackensack, NJ 07606

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 201-489-0525

Fax: 201-489-6320

Person Contacted:

- Mr. David Smith

Title:

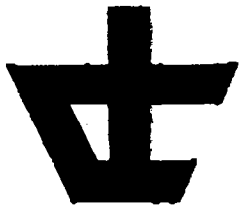
President

Contact Summary: (see attached pages as necessary)

Mr. Smith was contacted to determine the current state of installed emissions control equipment dedicated to aeration rooms/chambers at ethylene oxide sterilization/fumigation operations. Specifically, he was asked for any information regarding facilities to whom Damas had sold control devices specifically for aeration room vents.

Mr. Smith stated that Damas Corporation had sold two control device that were specifically designed to control aeration room emissions. These devices were significantly modified to address the high flow rate-low ethylene oxide concentration characteristics of aeration room emissions, and has since removed this fugitive emission scrubber from the market. According to Mr. Smith, the facility in which these devices were installed was required to control aeration room vent emissions to an efficiency of greater than 99 percent by the State. Mr. Smith emphasized the high costs (both initial capital costs and recurring annual operation costs) of aeration room vent controls. These costs are particularly high when the emission reduction is greater than 95 percent (a theoretical estimate of the costs for controlling a commercial aeration room [40' x 40' x 20' = 32,000 cubic feet] is \$100,000 to control the first 95 percent of emissions, and an additional \$150,000 to control the remaining 3-4 percent of emissions). *{note that this was not an official price quote, but a "ballpark estimate".}*

CONFIRMATION	8/21/92
RESPONSE	for attached
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

**damas****corporation**

8 ROMANELLI AVE.
SO. HACKENSACK, NJ 07606
(201) 489-0525
FAX (201) 489-6320

DATE: October 21, 1992

TO: David G. Hearne, MRI-NCO

FROM: David M. Smith

RE: Additions and corrections of my verbal remarks to you as contained in your fax to me of October 21, 1992. All additions and corrections are underlined.

Mr. Smith was contacted to determine the current state of installed emissions control equipment dedicated to aeration rooms/chambers at ethylene oxide sterilization/fumigation operations. Specifically he asked for any information regarding facilities to whom Damas had sold control devices specifically for aeration room vents.

Mr. Smith stated that Damas had sold two control devices that were specifically designed to control aeration room emissions. This device was significantly modified to address the high flow rate-low ethylene oxide concentration characteristics of aeration room emissions and has removed the fugitive emission scrubber from the market. According to Mr. Smith, the facility in which these devices were installed was required to control aeration room vent emissions to an efficiency of greater than 99 percent by the state. Mr. Smith emphasized the high costs (both initial capital costs and recurring annual operation costs) of aeration room vent controls. These costs are particularly high when the emission reduction is greater than 95 percent (a theoretical estimate of the costs for controlling a commercial aeration room [40' x 40' x 20' = 32,000 cubic ft.] is \$100,000 to control the first 95 percent of emissions, and an additional \$150,000 to controll the remaining 3-4 percent of emissions). {note that this was not an official price quote, but a "ballpark estimate".}


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OAQPS AIR
DOCKET CONTROL ROOM**A-88-03**

II E 406

CONTACT REPORT
Project No. 6501-53-52

David G. Hearne, MRI-NCO

Date of Contact: October 21, 1992

Date of Report: November 1, 1992

Company: Donaldson Company, Inc.
Address: Post Office Box 1299
1400 West 94th Street
Minneapolis, MN 55440-1299

Contacted by:
Telephone (X)
Visit at MRI ()
Visit There ()

Telephone: 612-887-3131

Fax: 612-887-3612

Person Contacted:

- Mr. Frederick Schmidt

Title:

Sales Engineer/Account Manager

Contact Summary: (see attached pages as necessary)

Mr. Schmidt was contacted to determine the current state of installed emissions control equipment dedicated to aeration rooms/chambers at ethylene oxide sterilization/fumigation operations. In March of 1992, Mr. Schmidt supplied EPA with a list of facilities having controlled aeration room vents. At this time, Mr. Schmidt was contacted to see if any information was available regarding additional facilities to whom Donaldson had sold control devices specifically for aeration room vents.

Mr. Schmidt stated that the number of facilities with installed aeration room vent controls had increased since the March, 1992 information. He stated that he would review the March information and send/fax updated information to me within the next few days.

This updated information (provided in a memorandum dated January 30, 1992) included the names and contact persons for three additional facilities which had installed control devices on their aeration room vents. Mr. Schmidt added that additional facilities are waiting for a Federal regulation before adding these controls.

CONFIRMATION	<u>VI/3/92</u>
RESPONSE	
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
NONE	<input type="checkbox"/>

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OAQPS AIR
DOCKET CONTROL ROOM

A-88-03

II E 407

CONTACT REPORT
Project No. 6501-53-52

David G. Hearne, MRI-NCO

Date of Contact: December 11, 1992

Date of Report: December 23, 1992

Company: Donaldson Company, Inc.
Address: Post Office Box 1299
1400 West 94th Street
Minneapolis, MN 55440-1299

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 612-887-3131

Fax: 612-887-3612

Person Contacted:

Title:

- Mr. Frederick Schmidt

Contact Summary: (see attached pages as necessary)

Mr. David Markwordt (U.S. Environmental Protection Agency) and I participated in a conference call with Mr. Schmidt.

Mr. Schmidt was contacted regarding the enhanced monitoring requirements to be specified in the proposed ethylene oxide (EO) commercial sterilization and fumigation NESHAP. Specifically, information was solicited regarding what parameters were routinely measured at facilities using Donaldson catalytic oxidation units, and the applicability of these parameters towards enforceability of potential standards.

Mr. Schmidt stated that operators at EO commercial sterilization and fumigation facilities typically use a chart recorder to record the oxidation temperature whenever the unit is operating. However, he stated that the oxidation temperature will vary significantly depending on the type of materials being sterilized (i.e., the "cycle" being used), and that the oxidation temperature would therefore not be an accurate indicator of control device performance. He also indicated that the oxidation temperature would not be an accurate indicator of the efficiency of the control device because of varying environmental conditions (e.g., ambient temperature) from cycle to cycle. He stated that the oxidation temperature monitoring devices for these control units typically ranged from 280 to 420 degrees Fahrenheit, and that calibration and sensitivity would be a potential problem if these data were to be used for enforcement purposes. Furthermore, Mr. Schmidt noted that there is no detectable exotherm within the catalyst bed when processing

aeration or other fugitive emissions. Hence, there is no indicator of system efficiency when processsing these low level ethylene oxide concentrations.

Mr. Schmidt first suggested that the standard be written based on the cycle being sterilized. However, after a discussion of the difficulties associated with writing such a standard, he suggested that the standard be written based on the effluent concentration of EO from the control device.

When asked, Mr. Schmidt stated that he would assemble additional information regarding other potential enhanced monitoring parameters and would forward this information to Mr. Markwordt as soon as possible.

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DOCKET CONTROL ROOM**A-88-03**

II E 408

CONTACT REPORT
Project No. 6501-53-52

David G. Hearne, MRI-NCO

Date of Contact: December 14, 1992

Date of Report: December 14, 1992

Company: Chemrox, Inc.
Address: 217 Long Hill Crossroads
Shelton, CT 06484

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 203-926-9081

Fax: 203-926-9334

Person Contacted:Title:

- Mr. Tim Sutherland

Engineer

Contact Summary: (see attached pages as necessary)

Mr. Sutherland was contacted regarding the enhanced monitoring requirements to be specified in the proposed ethylene oxide (EO) commercial sterilization and fumigation NESHAP. Specifically, information was solicited regarding what parameters were routinely measured at facilities using Chemrox scrubber units, and the applicability of these parameters towards enforceability of potential standards.

Mr. Sutherland stated that the flow rate [of EO-laden air?] through the scrubber, temperature of the scrubber liquor, pH of the scrubber liquor, and the volume of the scrubber liquor were routinely measured at most EO commercial sterilization and fumigation facilities using Chemrox detoxification towers. He added that the ethylene glycol concentration of the scrubber liquor was NOT typically measured and that most facilities rely on the measurement of the volume of the scrubber liquor as an indicator of when liquor change-out should occur. This volume measurement provides greater lead time to the facilities for determining when the liquor should be changed. Mr. Sutherland also stated that EO commercial sterilization and fumigation facilities routinely measure the ambient concentrations of EO in the workplace (which are typically in the 0.5 to 1.0 parts per million [ppm] range). These concentrations are measured for Occupational Safety and Health Administration regulatory compliance. He stated that the effluent EO concentrations were NOT routinely measured because of the difficulty in using the effluent concentration data to determine emissions efficiency given the flow dynamics of the sterilization process. However, he stated that some facilities do measure the effluent EO concentration infrequently as a cross-check for determining proper operation of the scrubber.

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DOCKET CONTROL ROOMCONTACT REPORT
Project No. 6501-53-52

David G. Hearne, MRI-NCO

Date of Contact: February 26, 1993

Date of Report: February 26, 1993

Company: Damas Corporation
Address: 8 Romanelli Avenue
South Hackensack, NJ 07606

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 201-489-0525

Fax: 201-489-6320

Person Contacted:

- Mr. David Smith

Title:

President

Contact Summary: (see attached pages as necessary)

Mr. Smith was contacted to request any available test data that substantiate the change-out of scrubber liquor for Damas' ethylene oxide scrubber for commercial sterilization facilities. Specifically, data correlating control device efficiency and ethylene glycol concentration were requested.

Mr. Smith stated that the indicator for recommended scrubber liquor change-out for this device is a 60 percent ethylene glycol concentration is the liquor. This scrubber liquor ethylene glycol concentration is a conservative value based on theoretical calculations of the conversion of ethylene oxide to ethylene glycol under the conditions present in the scrubber. He stated that they did not have actual test data showing a decrease in scrubber efficiency when the ethylene glycol concentration exceeds 60 percent (other than the theoretical calculations). He added that Damas had previously submitted all data on these devices to EPA.

CONFIRMATION
RESPONSE
WRITTEN <input type="checkbox"/>
VERBAL <input type="checkbox"/>
NONE <input checked="" type="checkbox"/>

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OAQPS AIR
DOCKET CONTROL ROOM

CONTACT REPORT
Project No. 6501-53-52

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CONFIRMATION	<u>III</u> / <u>25/93</u>
	II E 410
RESPONSE	<u>by fax</u>
WRITTEN	<input checked="" type="checkbox"/>
VERBAL	<input type="checkbox"/>
DATE OF CONTACT	March 23, 1993
DATE OF REPORT	March 24, 1993

David G. Hearne, MRI-NCO

Company: Donaldson Company, Inc.
Address: Post Office box 1299
1400 West 94th Street
Minneapolis, MN 55440-1299

Contacted by:
Telephone (X)
Visit at MRI (☐)
Visit There (☐)

Telephone: 612-887-3612

Fax: 612-887-3612

Person Contacted:

- Mr. Frederick Schmidt

Title:

Sales Engineer/Account Manager

Contact Summary: (see attached pages as necessary)

Ms. Beth Friedman (MRI) and I participated in a conference call with Mr. Schmidt.

Mr. Schmidt was contacted regarding the enhanced monitoring requirements to be specified in the proposed ethylene oxide (EO) commercial sterilization and fumigation NESHAP. Specifically, information was solicited regarding parameters that are routinely measured (or could be easily measured) at facilities using Donaldson catalytic oxidation units, and the potential for using these parameters as indicators of compliance and non-compliance with an emissions standard for sterilizer vent emissions. This discussion followed a review of the enhanced monitoring provisions specified in the 1990 Amendments to the Clean Air Act and a review of the difficulties associated with direct measurements of compliance (i.e., continuous measurement of the emission reduction achieved by a control device for each given emission stream).

Mr. Schmidt stated that chart recorders were routinely used at most facilities using Donaldson catalytic oxidation units to control emissions from sterilizer vents. These chart recorders record the temperature of the catalyst bed or the outlet temperature as measured by a thermocouple. He added that the installation of these chart recorders at a facility not currently using these devices would only entail minimal expense. Mr. Schmidt stated that the response of the catalyst bed temperature to a given quantity of EO was predictable and relatively consistent between sterilization cycles. At present, sources are encouraged to pick representative (i.e., most frequently used) cycle conditions and verify whether the catalyst bed consistently reaches a given temperature. As long as this catalyst bed temperature is reached

(e.g., $\pm 5-10^{\circ}\text{F}$), the efficiency of the control device as determined during a compliance test is assured.

However, Mr. Schmidt also stated that the temperature data were not capable of correctly indicating that a source is out of compliance with an emission reduction standard. The only conclusion that may be drawn from an insufficient catalyst bed temperature response is that something is not operating correctly within the emissions control system. It is possible for an insufficient catalyst bed temperature response to be seen while the control device is still meeting the emission reduction standard.

Mr. Schmidt confirmed that, as stated in his letter to David Markwordt dated January 12, 1993, Donaldson recommends annual emissions testing (conducted by the control device manufacturer) as a appropriate means of demonstrating compliance. Mr. Schmidt added that these tests typically cost \$2,000 to \$2,500 when performed by Donaldson. These costs were broken down as a \$700 fee plus the actual travel expenses for the technician conducting the test.

Mr. Schmidt was encouraged to submit any additional information regarding potential parameters that may be used for enhanced monitoring of these catalytic oxidation units.

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DOCKET CONTROL ROOM

CONTACT REPORT

Project No. 6501-53

A-88-03
II-E-411

David G. Hearne, MRI-NCO

Date of Contact: August 11, 1993

Date of Report: August 16, 1993

Company: International Sensor
Address: 17771 Fitch Street
Irvine, California 92714

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 714-863-9999

Fax: 714-474-7417

Person Contacted:

Title:

- Mr. Jack McCann

Sales and Marketing Manager

Contact Summary: (see attached pages as necessary)

Mr. McCann was contacted regarding International Sensor's manufacture of devices to monitor ethylene oxide emissions. In planning regulation of commercial sterilizers, EPA may require monitoring of EO emissions from the aeration room vents, chamber exhaust vents, and (possibly) main sterilizer vents.

Mr. McCann stated that International Sensor sold several devices used to monitor ethylene oxide (EO) emissions. These devices included monitors for high-flow, high-concentration EO monitoring (as would be seen in the emissions from a sterilizer vent) and for low concentrations of EO (down to 1 ppm with proper calibration).

Concerning monitors for the sterilizer vent, Mr. McCann stated that there were several factors that should be considered in regards to the placement of these monitors. Because of the necessity of monitor calibration (as with any monitor), it was preferable to have an external sensor that used some type of sampling system to sample the exhaust stream (as opposed to a monitor physically mounted in the exhaust stream). Potential temperature, condensation, and particulate contamination effects associated with the high-flow conditions of sterilizer vent emissions also made an external monitor preferable, since their potential effects can be addressed by a suitably designed sampling system.

Concerning monitors for high concentrations of EO typically encountered with chamber exhaust vents, Mr. McCann stated that these monitors were available and that they could be

equipped with an alarm system to advise the owner or operator when a preset limit was being exceeded. He added that these monitors had been used at chemical manufacturing facilities to monitor leaks in process lines (leaks, if they occurred, would occur at high concentrations).

Concerning monitors for low concentrations of EO typically encountered with aeration room vents, Mr. McCann stated that fairly accurate monitoring down to 1 ppm was possible given proper calibration of the monitor. These monitors are frequently equipped with an alarm feature to signal when a preset limit (typically based on State or OSHA regulations) has been exceeded. Potential difficulties associated with these low-concentration monitors included the availability of calibration gases, the potential impacts of tubing on the accuracy of the monitor for instrument types that measure the EO by pumping sample back to a central analysis unit via tubing (e.g., chromatographs, infrared analyzers).

Mr. McCann added that he would send product information on these sensors to me as soon as possible.

International Sensor Technology
17771 Fitch Street • Irvine, California, U.S.A. 92714
Tel: (714) 863-9999 • Tlx: 4722070 • Fax: (714) 474-7417

Date: August 13, 1993 Total Pages: 1 ~~1~~ ⁺² Fax Msg Number: 12195
To: MIDWEST RESEARCH INSTITUTE
Attn: David Hearne
From: Jack McCann
Ref: Your fax dated August 11, 1993

Thank you for your fax.

As we discussed on the phone, I am in the process of sending you information on IST Monitors capable of detecting ethylene oxide and some other information as well. A copy of my letter is attached. Concerning your Contact Report, I thought that a few minor changes might be in order. I am uncertain as to whether you wanted me to have your report re-typed to include the suggested changes. For now, I have merely marked up your report in pen, showing the suggested changes. If this is not suitable for your purposes please let me know.

Sincerely,



Jack McCann
Sales and Marketing Manager

JM:cp

encl: Contact Report

CONTACT REPORT

Project No. 6501-53

David G. Heame, MRI-NCO

Date of Contact: August 11, 1993

Date of Report: August 11, 1993

Company: International Sensor
Address: 17771 Fitch Street
Irvine, California 92714

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 714-863-9999

Fax: 714-474-7417

Person Contacted:

- Mr. Jack McCann

Title:

Sales and Marketing Manager

Contact Summary: (see attached pages as necessary)

Mr. McCann was contacted regarding International Sensor's manufacture of devices to monitor ethylene oxide emissions. In planning regulation of commercial sterilizers, EPA may require monitoring of EO emissions from the aeration room vents, chamber exhaust vents, and (possibly) main sterilizer vents.

Mr. McCann stated that International Sensor sold several devices used to monitor ethylene oxide (EO) emissions. These devices included monitors for high-flow, high-concentration EO monitoring (as would be seen in the emissions from a sterilizer vent) and for low concentrations of EO (down to 1 ppm with proper calibration).

Concerning monitors for the sterilizer vent, ^{sampling} Mr. McCann stated that there were several factors that should be considered in regards to the placement of these monitors. Because of the necessity of monitor calibration (as with any monitor), it was preferable to have an external sensor that used some type of vacuum system to sample the exhaust stream (as opposed to a monitor physically mounted in the exhaust stream). Potential temperature, condensation, and particulate contamination effects associated with the high-flow conditions of sterilizer vent emissions also made an external monitor preferable, *since their potential effects can be addressed by a suitably designed sample system.*

Concerning monitors for high concentrations of EO typically encountered with chamber exhaust vents, Mr. McCann stated that these monitors were available and that they could be equipped with an alarm system to advise the owner or operator when a preset limit was being

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exceeded. He added that these monitors had been used at chemical manufacturing facilities to monitor leaks in process lines (leaks, if they occurred, would occur at high concentrations).

Concerning monitors for low concentrations of EO typically encountered with aeration room vents, Mr. McCann stated that fairly accurate monitoring down to 1 ppm was possible given proper calibration of the monitor. These monitors are frequently equipped with an alarm feature to signal when a preset limit (typically based on State or OSHA regulations) has been exceeded. Potential difficulties associated with these low-concentration monitors included the availability of calibration gases and the potential impacts of tubing on the accuracy of the monitor, *for instrument types that measure the EO by pumping sample back to a central analysis unit via tubing (examples: chromatographs, infrared analyzers).*

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CONTACT REPORT

Project No. 6501-53

OAQPS AIR
DOCKET CONTROL ROOM

David G. Hearne, MRI-NCO

Date of Contact: August 12, 1993

Date of Report: August 12, 1993

Company: California Air Resources Board
Address: Process Evaluation Section
Toxic Air Contaminant Control Branch
Post Office Box 2815
Sacramento, California 95812

Telephone: 916-322-6023

Fax: 916-327-5621

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Person Contacted:

Title:

- Mr. Cliff Popejoy

Manager

Contact Summary: (see attached pages as necessary)

Mr. Popejoy was contacted regarding the definition of "aeration rooms" used by CARB in their regulation of ethylene oxide commercial sterilizers. Mr. Charles Kohlmeyer from Baxter Healthcare Corporation [in a conversation with Mr. David Markwordt (EPA/ESD/CPB)], had recommended that this definition could be readily used in Federal regulations of the industry.

Mr. Popejoy stated that the definition of aeration room used in the final regulation for EO sterilization was similar to the definition in the proposed regulation. He is sending a copy of the final regulation to me. He also inquired about the status of the Federal MACT standard. I provided him with a brief outline of the Agency's approach (MACT standard for major sources, GACT standard for area sources emitting greater than 1 ton per year). When discussing the Agency's approach for the aeration room standard (1 ppm emission limitation), Mr. Popejoy added that the California regulations take a similar approach (0.2 ppm emission limitation) because of potential problems associated with the limits of detection for EO.

Mr. Popejoy added that CARB has been advised of a new technology for controlling emissions at hospital sterilizers. This technology (from at least two manufacturers) involves reclamation of both EO and CFC's from the 12/88 EO mixture. He added that reports from the vendors indicated that this technology achieved up to 99.5 percent reduction in EO emissions. Mr. Popejoy stated that the California regulations for hospital EO sterilizers required a 99.9 percent emissions reduction but that they were investigating the possibility of allowing this new

technology given the concurrent reduction in CFC emissions.

Mr. Popejoy expressed an interest in reviewing the proposal package and in providing assistance to EPA in the development of these NESHAP. I stated that I would forward a copy of the Commercial Sterilization Background Information Document and would contact Mr. Markwordt regarding his offer to review and comment on the proposal package.

Approved
ETHYLENE OXIDE AIRBORNE TOXIC CONTROL MEASURE
FOR STERILIZERS AND AERATORS
with Proposed 15-Day Changes

17 CCR, Section 93108. Ethylene Oxide Airborne Toxic Control Measure--
Sterilizers and Aerators

(a) Definitions. For the purposes of this section, the following definitions shall apply:

- (1) "Acute care facility" means any facility currently licensed by the California Department of Health Services as a general acute care hospital (as defined in Title 22, CCR, Section 70005), or any military hospital.
- (2) "Aeration" is the process during which residual ethylene oxide dissipates, whether under forced air flow, natural or mechanically assisted convection, or other means, from previously sterilized materials after the sterilizer cycle is complete.
- (3) "Aeration-only facility" means a facility which performs aeration on materials which have been sterilized with ethylene oxide at another facility.
- (4) "Aerator" means any equipment or space in which materials previously sterilized with ethylene oxide are placed or remain for the purpose of aeration. An aerator is not any equipment or space in which materials that have previously undergone ethylene oxide sterilization and aeration can be handled, stored, and transported in the same manner as similar materials that have not been sterilized with ethylene oxide.
- (5) "Aerator exhaust stream" means all ethylene oxide-contaminated air which is emitted from an aerator.
- ~~(6) "Back-draft valve exhaust stream" is the air stream which results from collection of ethylene oxide-contaminated air which may be removed from the sterilizer through a back-draft valve or rear chamber exhaust system during unloading of the sterilized materials.~~
- 6(7) "Control device" means an article, machine, equipment, or contrivance which reduces the amount of ethylene oxide between its inlet and outlet and which is sized, installed, operated, and maintained according to good engineering practices, as determined by the district.
- 7(8) "Control efficiency" is the ethylene oxide (EtO) mass or concentration reduction efficiency of a control device, as measured with ARB Test Method 431 (Title 17, CCR, Section 94143) according to the source testing requirements herein, and expressed as a percentage calculated across the control device as follows:

$$\frac{\Sigma \text{EtO in} - \Sigma \text{EtO out}}{\Sigma \text{EtO in}} \times 100 = \% \text{ Control Efficiency}$$

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OAGPS AIR
DOCKET CONTROL ROOM**CONTACT REPORT**
Project No. 6501-53**David G. Hearne, MRI-NCO**

Date of Contact: August 19, 1993

Date of Report: August 19, 1993

Company: Baxter Healthcare Corporation
Address: One Baxter Parkway
Deerfield, Illinois 60015

Contacted by:	
Telephone	(X)
Visit at MRI	()
Visit There	()

Telephone: 708-948-4040**Fax:** 708-948-3347**Person Contacted:**

- Mr. Charlie Kohlmeier

Title:Vice President of Corporate
Facilities Engineering**Contact Summary:** (see attached pages as necessary)

Mr. Kohlmeier was contacted to obtain information about ethylene oxide (EO) monitors used at sterilization chamber, aeration room and chamber exhaust vents. Mr. Kohlmeier was contacted as a follow-up to a conversation he had with Mr. David Markwordt (EPA/ESD/CPB).

Mr. Kohlmeier stated that he had discussed possible continuous monitoring parameters for this source category with at least one other industry expert. In their opinion, the monitoring of ethylene glycol as a measure of compliance for acid water scrubbers would not be suitable. Mr. Kohlmeier cited the potential formation of poly-glycols in the scrubber liquor as a major concern with this enhanced monitoring protocol. Mr. Kohlmeier stated that direct monitoring of the EO emissions would be a more suitable alternative.

Mr. Kohlmeier stated that he was familiar with the monitors manufactured by International Sensor and had seen them used for monitoring ambient EO concentrations to meet OSHA requirements for workplace EO exposure. He was not aware of any use of these monitors in a process stream. Even though he stated that direct monitoring of EO concentrations was his preferred choice for enhanced monitoring of these sources, Mr. Kohlmeier did have some concerns with this direct monitoring of EO emissions. He stated that the monitor could indicate an incorrect "high" reading (and therefore an exceedance of the standard) as a result of another VOC present in the emissions stream that was not attributable to the sterilization process (e.g., VOC originating from the glues and adhesives used in the containers holding the products

CF Kohlmeier
8/24/93

being sterilized). Mr. Kohlmeier also stated that monitoring of the temperature change across the control device (ΔT) may be worthy of investigation as a possible alternative monitoring protocol.

We also discussed potential definitions of aeration room (including "aerator," "aeration," and "aeration room") with special focus on the definitions of these terms in the California Air Resources Board (CARB) and South Coast (California) Air Quality Management District (SCAQMD) regulations for EO sterilization. Mr. Kohlmeier stated that the definition of aeration room in the Federal regulations should include the elements of the CARB and SCAQMD definitions as they relate to the storage of sterilized materials after aeration. Mr. Kohlmeier stated that he had worked with both CARB and SCAQMD in their development of EO regulations, and suggested the linkage of aeration room to the OSHA workplace standard for EO (i.e., that "aeration" is NOT the storage of sterilized materials under conditions where ambient concentrations of EO are less than the OSHA workplace standard even though some residual EO may be offgassed from the sterilized materials). Mr. Kohlmeier believes that the CARB and SCAQMD regulations did not incorporate the OSHA reference because of their hesitancy over linking a State regulation to a Federal regulation, however the promulgated regulations do incorporate language that limits "aeration" to a distinct part of the sterilization process (the regulations state that "aeration" is not the storage/handling of sterilized materials in a manner that is indistinguishable from the storage/handling of non-sterilized materials).

Mr. Kohlmeier's concern with the present draft definition of "aeration room" in the NESHAP is that, because there will be low levels of EO offgassed from the sterilized materials after the materials are removed from the aeration room, owners or operators of aeration rooms might be required to control of these emissions even though they are below the OSHA limits. He suggests the incorporation of the OSHA limit as a means of determining when "aeration" of the sterilized materials is completed.

CFKohl
8/24/93

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A-88-03

II-E-414

INDUSTRY MEETING MINUTES**ETHYLENE OXIDE COMMERCIAL STERILIZATION AND FUMIGATION NESHAP****FEBRUARY 11 and 22, 1994**

The first meeting (February 11, 1994) took place via telephone. The following persons participated in this conference call:

Name	Company/Organization	Telephone	Fax
Allen Ammerman	Griffith Micro Science	708-654-5150	708-654-5181
Anne Baldwin	Health Industries Manufacturing Association	202-452-8240	202-289-1978
Pankaj Desai	Chemrox, Inc.	203-926-9081	203-926-9334
David Hearne	Midwest Research Institute	919-677-0249	919-677-0065
Charlie Kohlmeyer	Baxter Healthcare Corporation	708-948-4040	708-948-3347
David Markwordt	U.S. Environmental Protection Agency	919-541-0837	919-541-3470
Cary Olson	Donaldson Company, Inc.	612-887-3131	612-887-3612
Jerry Czwidrzynski	Isomedix, Inc.	901-757-4030	901-757-5462

The scope of the agenda prepared by Mr. Kohlmeyer (attached) was followed, however the order of discussion of issues varied. In general, discussion of issues related to packed-bed scrubbers used to control emissions from sterilization chamber vents, chamber exhaust vents, and aeration room vents occurred first. This was followed by a discussion of issues related to catalytic oxidizers and then flares used to control emissions from these vents. A synopsis of the specific issues discussed follows.

I. Acid-Water Scrubbers.

Mr. Desai reviewed the "important parameters" for the operation of the scrubber. They are: total gas flow rate into the scrubber (he stated that the scrubber is designed to have a certain gas flow rate, and that if the actual flow rate falls below this designed value, the efficiency of the scrubber would be affected); liquid flow rate in the packed tower (if this falls below a certain value the efficiency could be affected; if the value is exceeded, flooding

of the packed tower could occur -- however most systems have alarms that shut the system down if flooding is likely)¹; temperature of the liquor (the temperature increases in response to the reaction of ethylene oxide (EO) to ethylene glycol; this temperature increase must be controlled); pH of the liquor (affects the rate at which conversion of EO to ethylene glycol occurs, and must be below a certain value; however the pH will not typically vary once it is established at the beginning of a cycle for a liquor solution); and ethylene glycol concentration (the maximum glycol concentration at which a given emissions reduction is achieved is based on the design of the control system; typically 40 percent glycol, but could be designed for up to 60 percent glycol).² Mr. Desai noted that this maximum glycol concentration is rarely approached because of condensation of water in the tower. Water from the evacuation condenses in the scrubber liquor dilutes the glycol concentration. Mr. Desai reported actual ethylene glycol concentrations in spent scrubber liquor were typically 30 to 35 percent.

During a discussion of these parameters in regards to the draft regulation, it was noted that the gas flow rate would typically not vary but would be dependent on the vacuum pump evacuating the sterilization chamber. The liquid flow rate would be a likely parameter to be monitored. The temperature is typically controlled by a heat exchanger.

Mr. Desai stated that there were difficulties associated with the draft monitoring requirements and compliance provisions under which the ethylene glycol concentration of the scrubber liquor would be monitored as a means of determining compliance with the sterilization chamber vent standard where an acid water scrubber is used to control emissions. He stated that a gas chromatograph would be required to accurately measure the glycol concentration. An experienced technician would also be required. Mr. Desai acknowledged that six months would be sufficient to allow for the establishment of a maximum ethylene glycol concentration if the monitoring of this concentration is required.

¹ During a discussion of the more passive systems (i.e., Damas scrubbers) where the inlet gas is bubbled through the scrubber liquor, the consensus was that corollaries existed for these monitoring parameters: the inlet gas pressure is analogous to the total gas flow rate, and that the height of the liquid through which the gas is bubbling is analogous to the liquid flow rate. Gas flow rates (max pressure feed to tower), pH and temperature are the parameters that are most significant to the operation of the scrubber. The pH and ethylene glycol concentrations are typically measured just prior to disposal/recycling of the spent liquor. Note: this information was not provided by a Damas representative but by Mr. Desai and Mr. Kohlmeyer.

² A system could be designed that has larger (oversized) towers and/or a faster liquid flow rate that could achieve the same EO emissions control while allowing (for example) a 60 percent glycol concentration. Mr. Desai stated that this could be preferable because spent scrubber liquor solutions having a glycol concentration of greater than 50 percent were more readily accepted for recycling.

The parameters typically monitored on a continuous basis via a control panel in systems installed today are temperature, gas pressure at the inlet to the tower, and liquid flow rate. These parameters are not necessarily recorded. In many systems pH is not continuously measured because of calibration problems resulting in false alarms (ports are provided for sampling of pH from time to time). Glycol concentration is typically only measured at the beginning and end of a liquor cycle.

Mr. Desai and Mr. Kohlmeyer suggested that the gas and liquid flow rates and scrubber liquor temperature be monitored on a continuous basis during operation of the control device. Additionally, they suggested that the ethylene glycol concentration and pH be monitored at the beginning and end of the scrubber liquor cycles. Mr. Markwordt stated that from an enforcement perspective, if these latter measurements exceeded the limits established during a performance test, the source would be in violation of the standard for the entire scrubber liquor cycle. Additionally, questions were raised on the validity of having only two sampling points. Potential pH monitoring at the beginning of the scrubber liquor cycle was also suggested.

II. 5,300 ppm Standard for Chamber Exhaust Vent.

Mr. Desai also discussed the requirements for monitoring the EO concentration in the sterilization chamber prior to the operation of the chamber exhaust vent. Mr. Desai stated that measurement of this concentration would require an online gas chromatograph and technician. He suggested that provisions be allowed whereby a source could calculate the EO concentration in the sterilization chamber after the last air wash based on theoretical calculations. Mr. Desai asserted that this procedure would be sufficient because most sterilization cycles are fixed, are approved by the Food and Drug Administration (FDA), and are part of the record of sterilization maintained by the operators of the sterilizers. Mr. Desai stated that this information was maintained by FDA. The air wash data would be maintained for EO residual information. Mr. Kohlmeyer stated that sources maintain these data even though they are not specifically required to by FDA regulations. Mr. Desai added that the Occupational Safety and Health Administrator (OSHA) worker exposure requirements result in sources conducting more air washes than would be required to achieve the 5,300 ppm chamber exhaust standard.

Mr. Kohlmeyer stated that an option should be added to the chamber exhaust standard that allows sources controlling emissions from the chamber exhaust (presumably by installing separate control or by manifolding these emissions to controls for the aeration room vent) should be exempted from monitoring the EO concentration in the sterilization chamber prior to engaging the chamber exhaust. Mr. Kohlmeyer stated that most major sources would choose to control these emissions, and that the theoretical calculations or actual measurement of EO present in the chamber prior to the operation of the chamber exhaust vent would mostly be performed by the 2,000-20,000 lb/yr area sources.

Mr. Desai and Mr. Kohlmeyer stated that records are kept on all sterilization cycles that contain information on temperature and pressure during the cycles. New products would have new cycles developed for them as needed. They suggested that records of the cycles performed (including the cycle performed, amount of EO charged to the chamber, temperature, and pressure changes) be allowed as a surrogate for the EO monitoring requirement as a determination of compliance with the 5,300 ppm chamber exhaust standard.

III. Catalytic Oxidizers.

Mr. Olson discussed monitoring issues for catalytic oxidizers.

A. Sterilization Chamber Vent.

Mr. Olson stated that the monitoring requirements for catalytic oxidizers were too stringent. The minimum starting temperature of the catalytic oxidation units is typically 280°F. As the EO is destroyed across the catalyst surface, the exotherm increased to approximately 460-500°F. There is an upper limit for the temperature of the catalyst bed that cannot be exceeded (or catalyst bed could be damaged). This maximum temperature is more important from an equipment operation standpoint rather than a compliance standpoint. The temperature response achieved by the unit (exotherm profile of temperature plotted against time) would be the same for a given cycle but could vary significantly when different products are sterilized (depending on the amount of EO retained by the product and other conditions of the cycle -- temperature, pressure, vacuum cycles performed, amount of EO charged). The temperature is a fairly good broad-based parameter to use for an indicator of performance (given the same exotherm); however the temperature is not a 100-percent accurate indicator of performance. Dramatic changes in the temperature profile will not occur between cycles unless the maximum temperature is exceeded, and/or the catalyst bed is damaged.

Mr. Markwordt stated that the monitoring requirements could be changed to require monitoring of the temperature change in response to a given charge of EO. This temperature change would be monitored during the first evacuation of the chamber. Mr. Olson stated that this would make sense but would be more challenging for contract sterilizers performing varying sterilization cycles on different materials.

Mr. Olson stated that currently, changes in the temperature profiles (drop in temperature from a previous profile) are used as indicators that "something" may be wrong with the control device. Mr. Kohlmeyer and Mr. Olson stated that other parameters used as indicators include air flow rate, burner air flow rate, low and high bed temperatures, and burner flame presence (these parameters are monitored but not necessarily recorded).

Mr. Kohlmeyer and Mr. Olson stated that a potential complication to exotherm monitoring was that some facilities manifold several sterilization chambers to a single

catalytic oxidizer. This would present difficulties to monitoring the exotherm because the control device could be receiving flows from more than one chamber at different points in the sterilization cycle for each chamber. Although the correlation of exotherms between cycles would be an acceptable compliance provision for single chamber systems, this correlation would not be possible for multiple chamber systems.

Mr. Kohlmeyer stated that the use of a minimum temperature rise as a compliance parameter would depend on what materials are being sterilized, and the cycle being performed. Mr. Olson suggested that, during a performance test, a facility could use the minimum amount of EO charged to the sterilizer in any of the cycles performed in that sterilizer, and establish a minimum temperature response in the catalytic oxidizer. As long as that minimum temperature is achieved during any other cycles, there would be a reasonable indicator of performance of the control device. Mr. Hearne noted that since the initial performance test is performed using an empty chamber, this minimum temperature might not be achieved if materials that retain a relatively high amount of EO are sterilized. It was noted that contract sterilizers would potentially have difficulties choosing which cycle results in this minimum temperature rise.

No definite recommendations for alternative monitoring requirements or compliance provisions for catalytic oxidizers resulted from this discussion, however, it was agreed that the issues discussed were important, and would be discussed again during a planned meeting with EPA Office of Enforcement and Emissions Measurement Branch representatives. This meeting was tentatively planned for February 22, 1994.

B. Aeration Room Vent.

Mr. Kohlmeyer and Mr. Olson noted that the majority of sterilization facilities that control emissions from the aeration room vent do so by using catalytic oxidation. Mr. Olson noted that the concentration of EO entering the control device is not great enough to cause an increased temperature profile. The slight increase exhibited ($\pm 2^{\circ}\text{F}$) could be the result of normal fluctuations in the temperature of the device. Mr. Olson proposed the use of quarterly or semi-annual checks on the efficiency of the devices as an indicator of compliance following the initial performance test where performance is shown. no degradation of the catalyst would be expected during operation over the quarter or semi-annual period. Mr. Olson reported that catalyst beds have been operating for up to eight years and are still showing the same level of emissions reduction.

Mr. Kohlmeyer proposed a minimum temperature of the catalyst bed as a parameter to be measured to indicate continuous compliance per the enhanced monitoring requirements. This temperature could be established during a performance test and monitored thereafter. Mr. Markwordt noted that the standard for aeration room vents is written as a parts per million standard. Direct measurement is more practicable for this type of standard as opposed to the efficiency standard written for the sterilization chamber vents.

Mr. Kohlmeyer suggested that the aeration room vent standard be written to allow a source the option to show either a 1 ppm maximum outlet EO concentration or a 99.9 percent emission reduction. He stated that measurement of the EO concentration on a continuous basis was impracticable in some cases due to interference by temperature and condensation factors; false exceedance readings could result. He therefore suggested that some minimum temperature coupled with periodic efficiency tests be adopted for the enhanced monitoring requirements for this vent.

Mr. _____ (Isomedix) noted that their facilities track the EO concentration during the sterilization cycles, however they do not monitor EO concentrations in any high temperature conditions (because of the potential for condensation and temperature interference).

IV. Flares.

Mr. _____ (Isomedix) noted that he was aware of three facilities that used flares to control emissions of EO (SC, TX, and MA). The parameters monitored include the natural gas pressure to the burner, combustion air flow, presence of a flame, and temperature in the burn zone. Mr. _____ reported that facilities had achieved an efficiency of 99.99 percent destruction of EO because of the volatility of EO. Mr. _____ noted that the testing of flares is quite complex, but was required of their facilities in Texas and Massachusetts. He agreed to send Mr. Markwordt a copy of the test methodology and results. Mr. Kohlmeyer also suggested contacting the Texas Air Control Board for additional information of flares.

V. Conclusion.

Mr. Markwordt noted that a future meeting would hopefully be arranged that would include EPA representatives from the Office of Enforcement, and Emissions Measurement Laboratory as well as the same parties in today's meeting. This meeting was tentatively scheduled for Tuesday, February 22, 1994. Mr. Kohlmeyer requested any additional information on enhanced monitoring. Mr. Markwordt and Mr. Hearne noted that the proposed enhanced monitoring regulation and reference document were available but that these references addressed existing NESHAP, and that these could differ from the enhanced monitoring requirements to be proposed for new NESHAP.

Mr. Markwordt advised that, because of scheduling requirements, the proposed regulation would not include any changes in response to information received during this meeting.

The second, follow-up, meeting (February 22, 1994) took place at EPA's Emission Measurement Laboratory in Research Triangle Park, North Carolina. Other attendees participated in the meeting via telephone. The following persons participated in this meeting:

Name	Company/Organization	Telephone	Fax
Allen Ammerman	Griffith Micro Science	708-654-5150	708-654-5181
Anne Baldwin	Health Industries Manufacturing Association	202-452-8240	202-289-1978
Jerry Czwidrzynski	Isomedix, Inc.	901-757-4030	901-757-5462
Rima Dishakjian	U.S. Environmental Protection Agency	919-541-0443	919-541-1039
David Hearne	Midwest Research Institute	919-677-0249	919-677-0065
Charlie Kohlmeier	Baxter Healthcare Corporation	708-948-4040	708-948-3347
David Markwordt	U.S. Environmental Protection Agency	919-541-0837	919-541-3470
Barry Page	Health Industries Manufacturing Association	202-452-8240	202-289-1978
Ellen Rattigan	U.S. Environmental Protection Agency	703-308-8531	703-308-8738

The topics of discussion at this meeting were the same as those discussed at the 11 February conference call. The purpose of the second meeting was to provide EPA representatives from the Office of Enforcement/Stationary Source Division (Ms. Rattigan) and Office of Air Programs and Standards/Emission Measurement Laboratory (Ms. Dishakjian) an opportunity to discuss issues associated with monitoring these batch operations. A synopsis of the specific issues discussed (other than those discussed at the 11 February Conference call) follows.

Acid-Water Scrubbers

The monitoring parameters recommend by the industry representatives for these control devices are: gas flow rate, liquid flow rate, and scrubber liquor temperature to be monitored continuously and recorded during operation of the scrubber. Additionally, the ethylene glycol concentration and pH of the liquor should be monitored and recorded at the beginning and end of the liquor cycle. It was noted that these parameters are already

routinely monitored but not recorded. Continuous monitoring of ethylene glycol was not recommended as an acceptable parameter to indicate compliance with a standard because of potential interference with oils and di-, tri-, and poly-glycols.

Mr. Markwordt inquired if it would be possible that the three suggested parameters could be within the proposed limits yet the ethylene glycol concentration could be above the concentration where the efficiency of the scrubber would decline. Mr. Kohlmeyer answered that this was possible, but that the ethylene glycol concentrations typically change gradually and predictably given the amount of EO entering the scrubber.

Ms. Rattigan stated that from an enforcement perspective, periodic monitoring of the ethylene glycol concentration would be preferable to only monitoring at the beginning and end of a liquor cycle. She suggested that monitoring requirements could be developed that required (for example) monthly monitoring of ethylene glycol concentrations for a given time. If the source has not shown any exceedances, the monitoring interval could be lengthened up to beginning and end of cycle monitoring.

Ms. Rattigan also questioned if the additional monitoring requirements could prompt sources to change their scrubber liquor more frequently and therefore increase the wastewater pollution from this source category. Mr. Kohlmeyer noted that it is difficult to recycle dilute concentrations of ethylene glycol, and that disposal of these dilute concentrations is the usual method of handling the more dilute spent scrubber liquors.

Ms. Dishakjian questioned if the regulation could be written to not require monitoring of the ethylene glycol concentration on a regular basis until a site-specific theoretically calculated ethylene glycol concentration was reached (based on the amount of EO charged to the sterilizer). It was felt that this approach would allow the source the option of changing the scrubber liquor or monitoring the ethylene glycol concentration.

Catalytic Oxidation

For catalytic oxidation units controlling emissions from aeration room vents, Mr. Ammerman suggested continuous monitoring of the minimum catalyst bed temperature with quarterly grab sampling of the EO concentrations upstream and downstream of the catalyst bed. Additionally, an allowance for sources to comply with a 1 ppm maximum emissions or 99 percent reduction standard for aeration room vents was suggested. In any event, Mr. Ammerman stated that direct monitoring of the EO concentration should not be required for aeration room vents. Ms. Rattigan stated that the monitoring of the minimum temperature for these vents would probably satisfy the goals of the Office of Enforcement.

Mr. Ammerman noted that the catalyst bed degrades over time, and that manufacturers recommend that the minimum operating temperature (i.e., temperature of the catalyst bed) be raised over time. Mr. Hearne noted that this seemed contradictory to the

establishment of a minimum oxidation temperature during the initial performance test. Mr. Ammerman noted that this degradation typically occurs within 3 to 5 years for a device attached to a sterilization chamber vent, and within 8 to 10 years for devices attached to aeration room vents. It was suggested that the compliance test during which the minimum temperature is established should be repeated (therefore establishing a new minimum temperature) every 2 years. Mr. Ammerman stated that he was aware of several facilities that were required to conduct annual performance tests in order to satisfy State regulations and permits. He suggested annual performance testing with corresponding establishment of the minimum temperature. Mr. Kohlmeyer stated that, in his experience, the sampling of the catalyst bed is more difficult than conducting a performance test for these units.

Flares

Mr. Czwidrzynski recommended the following monitoring requirements for flares: natural gas pressure to the burner, combustion air flow, presence of a flame, and temperature in the burn zone. Mr. Markwordt noted that he had received the test methodology from Isomedix, and that EPA typically did not consider Isomedix's control devices "flares."

Chamber Exhaust Vents

Mr. Kohlmeyer reiterated that the standard for the chamber exhaust vents should be written to allow a theoretical calculation of the concentration of EO remaining in the chamber following the final air wash. He and Mr. Page stated that the measurement of the EO concentration in the sterilization chamber is difficult at best, and that the Food and Drug Administration's (FDA's) regulations allowed an optional theoretical measurement of the EO concentration. They also stated that the sterilization cycles must be approved by FDA, and cannot change after that without re-approval. Mr. Kohlmeyer also stated that data submitted in comments on the proposed regulation will probably indicate the existence of a controlled MACT floor for major source chamber exhaust vents. He was uncertain on the existence of a controlled MACT floor for area sources.

ATTACHMENT 1

PROPOSED DISCUSSION ITEMS FOR 2/11/14 MEETING ON EO NESHAP

- Monitoring sterilizer chamber units using:
 - acid-based scrubbers
 - catalytic oxidizers
 - flares
- Monitoring method for aeration vents
- Monitoring method for chamber exhaust vents